

Effect of Chemotherapy on the Nutritional Status of Egyptian Patients with Breast Cancer

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Background: Chemotherapy and chemotherapy-related symptoms may greatly affect the nutritional status of the patient and reduces the quality of life.

Aim of the study: Assessment of the effect of chemotherapy on the nutritional status of breast cancer patients.

Methods: In this prospective observational study, we assessed the nutritional status of 60 breast cancer patients receiving chemotherapy by anthropometric measurements including body weight (BW), body mass index (BMI), triceps skin fold (TSF), and mid arm muscle circumference (MAMC). Symptoms related to chemotherapy were assessed with a yes/no questionnaire.

Results: Forty three patients (71%) experienced weight loss during the course of treatment. Compared to baseline assessment before starting chemotherapy, there was a significant reduction in the average of all parameters at the end of chemotherapy. Body weight decreased from 78.97 (± 9.6) kg to 73.65 (± 14.1) kg, BMI from 30.15 (± 3.2) kg/m² to 28.01 (± 4.8) kg/m², TSF from 4.23 (± 0.5) cm to 3.97 (± 0.68) cm and MAMC from 36.31 (4.02) cm to 34.61 (± 5.04) cm ($p < 0.001$ for all). Significant reduction in BMI observed in patients who experienced alteration in taste especially those with taste alteration for > 1 week ($p < 0.001$). Similarly, BMI reduction was significantly associated with loss of appetite and its duration ($p < 0.001$).

Conclusion: During chemotherapy, breast cancer patients are prone to lose weight particularly, those patients who experience taste alteration and appetite-loss for longer duration..

Key words: Breast cancer, Chemotherapy, Nutrition, Body mass index

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INTRODUCTION

Breast cancer is the commonest cancer in women account for about 23% of all cancer incidences¹. Most of the patients who have early-stage disease receive adjuvant chemotherapy, radiotherapy and hormonal treatment before or after surgery with the aim of prevention of disease recurrence². However, chemotherapy for breast cancer can result in multiple adverse effects such as nausea, vomiting, taste and smell changes, besides, loss of appetite that may interfere with proper dietary intake³.

Changes in food intake can affect the nutritional status of patients and may impact the disease prognosis. Evidence of weight changes from chemotherapy showed a worse prognosis for the cancer patient, both with weight gain and weight loss^{4,5}.

Data are scarce regarding weight changes observed during chemotherapy in Egyptian breast cancer patients. We, therefore, performed this prospective study to evaluate weight changes during

chemotherapy and the effect of chemotherapy related symptoms among a group of consecutive women with breast cancer treated at an Egyptian cancer center.

METHODS

Ethical approval

This prospective study was approved by the local institutional ethical committee. Written consents were obtained from patients after explanation of the nature and purpose of the study.

Study design

This is a prospective observational descriptive study conducted on breast cancer patients treated at Kasr AL-Ainy Center of Clinical Oncology and Nuclear Medicine (NEMROCK), Cairo University Hospitals and are scheduled to receive neoadjuvant or adjuvant chemotherapy for their disease.

Eligibility criteria

For inclusion in the study, female patients should have stage I-III histologically confirmed invasive duct carcinoma and scheduled to receive neoadjuvant / adjuvant chemotherapy. The patient should be more than 18 years, free of comorbid diseases and have the physical, verbal and cognitive ability needed to respond to the tools necessary to data collection. All -patients were included before starting the first cycle of chemotherapy.

Exclusion criteria

Patients with primary tumor site other than the breast or metastatic disease were excluded. Moreover, patients not planned to receive chemotherapy or those who started first cycle before inclusion in the study were also excluded.

Tools of data collection

To collect data for this research, we used the following tools:

1. Structured questionnaire through interviewing:

The first part included socio- demographic variables such as age, occupation, level of education, marital status and income. The second part included medical data sheet which covered variables such as current medical diagnosis, staging of the disease, type of surgery, timing of chemotherapy and number and duration of chemotherapy sessions.

2. Nutritional Assessment tools:

Adopted from Jarvis⁶ and modified and translated by El Feky⁷. The modification needed, validity and reliability were done by experts in the field of Medical Surgical Nursing specialty, Faculty of Nursing Cairo University.

Tools of assessment include:

- a. Anthropometric measurements that may be relevant measures of a cancer patient's nutritional status⁸ including; height, weight, body mass index (BMI), Triceps skin fold (TSF) and Mid-arm muscle circumference (MAMC).

The BMI was calculated by dividing weight by height squared (kg/m²). According to WHO standards, BMI categories were defined as: normal weight (<25 kg/m²), overweight (25–30 kg/m²), obese (≥30 kg/m²), and underweight (<18.5 kg/m²)⁹.

TSF which reflect fat mass was measured at the midpoint between the acromion and olecranon at the triceps muscle. MAMC which indicate the store of muscle protein was calculated using the formula:

MAMC (cm) = MAC (cm) – 3.14 × TSF (cm) where MAC is Mid-arm circumference (MAC) was measured at the same level as TSF¹⁰.

The normal ranges of MAMC and TSF in females are as follow: 21.2 – 25 cm and 21 – 25 mm, respectively¹⁰.

- b. Risk factors affecting nutritional status: it covers items answered by yes or no, including decreased appetite, taste alteration, nausea, vomiting.
- c. Dietary assessment: This includes dietary history and dietary habits.

Procedure

Data collection was carried out at three different times during the chemotherapy. The first assessment was completed before the first cycle of chemotherapy. The second assessment was after the intermediate cycle (2nd, 3rd, or 4th cycles if the patient was planned to receive 4, 6 or 8 cycles; respectively). Finally, the third assessment performed after the last cycle of chemotherapy.

Statistical Analysis

Data were statistically described in terms of mean ± standard deviation (± SD), median and range, or frequencies (number of cases) and percentages when appropriate. Correlation between various variables was done using Pearson moment correlation equation for linear relation in normally distributed variables and Spearman rank correlation equation for non-normal variables/non-linear monotonic relation. p values less than 0.05 was considered statistically significant. All statistical calculations were done using computer program SPSS (Statistical Package for the Social Science; SPSS Inc., Chicago, IL, USA) release 15 for Microsoft Windows (2006).

RESULTS

A total of 60 patients were recruited in the period between March 2014 and July 2014. Characteristics of the study population are shown in Table 1.

Disease characteristics and treatment received are summarized in Table 2. Most of the patients had stage II disease. All the patients received combination chemotherapy with anthracycline based treatment either in the adjuvant setting (78.3%) or in the neoadjuvant one (21.7%). Among the study subjects, who received adjuvant chemotherapy, 43.3% had radical mastectomy and 35% had lumpectomy. Ninety-three percent of the patients received 8 cycles of anthracycline-taxanes containing treatment.

The results of the anthropometric assessments are illustrated in Table 3. Prior to chemotherapy, 97% of patients were either overweight or obese. Moreover, TSF and MAMC parameters, both were above the normal range in the majority of patients. Seventy-one percent of our patients experienced weight loss during their treatment. During chemotherapy patients had progressive reduction in BMI, TSF and MAMC.

A comparison of the anthropometric measurements before *versus* after chemotherapy is shown in Table 4. The decrease in weight, BMI, TSF and MAMC was highly significant.

Table 5 shows the gastrointestinal toxicities and dietary habits of our patients.

Decreased appetite occurred in 78.3% of the patients in the second assessment, of which 30% experienced decreased

Table 1: Socio-demographic characteristics of patients

	No.	%
Age		
20 - < 30	3	5
30 - < 40	24	40
40 - ≤ 50	33	55
Mean ± SD	40.1 ± 6.3	
Marital status		
Single	3	5
Married	53	88.3
Divorced	2	3.3
Widow	2	3.3
Occupation		
Housewife	55	91.7
Employed	5	8.3
Education level		
Illiterate	9	15
< high school	32	53.3
High school	13	21.7
University	6	10

Table 2: Disease characteristics and treatment.

Variable	No.	%
Histological diagnosis		
Invasive duct carcinoma	60	100
Stage		
II	36	60
III	24	40
Surgery		
Modified radical mastectomy	26	43.3
Breast conservative surgery	21	35
None	13	21.7
Length of hospital stay during surgery		
< 1 week	46	76.7
≥ 1 week	1	1.7
None	13	21.7
Time of chemotherapy administration		
Before surgery (neoadjuvant)	13	21.7
After surgery (adjuvant)	47	78.3
Starting time of chemotherapy		
Without surgery	13	21.7
< 1 month post-surgery	40	66.7
1-2 months post-surgery	7	11.7
Number of chemotherapy sessions		
4	1	1.7
6	3	5
8	56	93.3
Duration and type of chemotherapy		
12 weeks (Anthracycline - Cyclophosphamide)	1	1.7
18 weeks (Anthracycline -Taxane)	3	5
24 weeks (Anthracycline -Taxane)	56	93.3

appetite for more than 1 week. This percent elevated to 81% in the third assessment. Also, taste alteration was experienced by 73.3% of the study subjects in the second assessment versus 83.3% in the third assessment.

Twenty nine patients representing 48.4% of the study subjects suffered from vomiting > grade II (2–5 episodes of vomiting in a 24-hour) after chemotherapy in the 2nd assessment. This percent decreased to 26.6% in the 3rd assessment. In the 2nd assessment, 61.7% had nausea that decreased to 33.3% in the 3rd assessment.

Eighty-three percent of the participants had regular daily meals before starting chemotherapy; this percentage decreased to 16.7% in the 3rd assessment. Moreover, the percentage of patients having 3 meals per day decreased from 85% in the 1st assessment to 26.7% at the end of chemotherapy in the 3rd assessment.

Table 6 shows a highly significant decrease in BMI in patients who experienced alteration in taste sensation. Participants with taste alteration for more than one week were at higher risk of weight-loss and BMI decrease. Loss of appetite had also a significant effect on loss of BMI at the end of the course of chemotherapy.

DISCUSSION

There is a debate on the effect of chemotherapy on weight gain in breast cancer patients with scarce data in Egyptians. This cross sectional study shows weight loss in the majority of patients with a significant decrease in BMI and other anthropometric measures after completing the course of chemotherapy. Changes in BW are valuable indicators of nutritional risk. In many cancer types, weight loss is an independent predictor of more toxicity from chemotherapy and shorter overall survival¹¹. Another tool for nutrition status assessment of a cancer patient in clinical practice is the BMI-decrease¹².

Based on the WHO classification of BMI, 97% of our breast cancer patients were overweight/obese at presentation. By the end of chemotherapy, this percentage decreased significantly to 72% with a significant reduction in the mean BMI. Data on weight changes as a consequence of chemotherapy showed different results. Some trials reported weight gain during adjuvant chemotherapy in 50–96% of all breast cancer patients. The median weight increase ranged from 1 to 6 kg along the treatment course and follow-up periods of up to 1 year^{13,14,17}. Noteworthy, trials that followed patients only through treatment have observed no weight gain^{15,16,18}.

In a similar trial, 18 breast cancer patients were followed-up during chemotherapy and also for 1 year after completion of treatment¹⁹. There was a lack of weight gain and even weight loss among the studied patients¹⁹. The baseline mean weight of 64.5 kg decreased to 64.3 kg at mid treatment, which may be due to reduction of energy intake during the course of treatment.

Table 3: Anthropometric measurements along the course of chemotherapy

Variables	1 st assessment (before the 1 st cycle)		2 nd assessment (after the mid-cycle)		3 rd assessment (after the last cycle)	
	No.	%	No.	%	No.	%
Body mass index						
Normal	2	3.3	7	11.7	17	28.3
Overweight	27	45	30	50	24	40
Obese	31	51.7	23	38.3	19	31.7
Mean ± SD	30.15 ± 3.17		29.06 ± 3.46		28.01 ± 4.76	
Triceps skin fold (TSF)						
Normal	1	1.7	2	3.3	2	3.3
Above normal	59	98.3	58	96.7	58	96.7
Mean ± SD	04.23 ± 0.5		04.08 ± 0.59		03.97 ± 0.68	
Mid-arm muscle circumference (MAMC)						
Normal	0	0	1	1.7	1	1.7
Above normal	60	100	59	98.3	59	98.3
Mean ± SD	36.31 ± 4.02		35.48 ± 4.33		34.61 ± 5.04	

Table 4: Comparison of the anthropometric parameters before versus after chemotherapy

Measurement	1 st assessment (before chemotherapy)		3 rd assessment (after chemotherapy)		p value
	Mean	SD	Mean	SD	
Weight	78.97	9.602	73.65	14.1	< 0.001
Body mass index (BMI)	30.1	3.185	28.01	4.762	<0.001
Triceps skin fold (TSF)	4.24	0.504	3.97	0.683	<0.001
Mid-arm muscle circumference (MAMC)	36.31	4.04	34.62	5.04	<0.001

In a nonrandomized prospective study, Kutynec *et al*¹⁸ followed the patients up pre and post treatment. Body weight was obtained at baseline and after 12 weeks, whereas chemotherapy didn't result in weight gain¹⁸. On the other hand, Heideman *et al* reported significant weight gain during the year after diagnosis with a mean weight gain of +2 kg¹³. Another trial performed by Irwin *et al* who assessed weight and body fat at baseline and after 2 years found an increase in weight by 1.7 ± 4.7 kg²⁰.

The discrepancy between previous researchers' results and ours may be attributed to the fact that previous trials followed the patients for at least one year after the end of chemotherapy. On the contrary, our study had a short follow up (24 weeks) during chemotherapy. Body weight and BMI during chemotherapy may be affected by decreased food intake as a result of chemotherapy related symptoms. Moreover, the majority (90%) of our patients were > 30 BMI at presentation, a group of patients may not be at a risk of developing weight gain. This is consistent with Nissen *et al* who reported that women of normal BW at the time of their breast cancer diagnosis are more prone to gain weight after chemotherapy than overweight or obese patients²¹.

Regarding other anthropometric measurements, the decrease in the mean TSF and MAMC also were evident at the end of chemotherapy denoting malnutrition among this group of patients.

Our research aimed to study the effect of chemotherapy on weight and BMI. In context, chemotherapy related side effects as nausea, vomiting and taste alteration may be a direct cause of weight loss in cancer patients and contribute to the deterioration of patients' nutritional status²². At the end of chemotherapy, the most frequent GI symptoms amongst our patients were decreased appetite (81%), taste alteration (83%) and nausea (33%) and vomiting (27%). A similar prevalence of GI symptoms was found in studies conducted by Lu *et al* who reported an incidence of taste changes (48.8%) among a group of cancer patients receiving chemotherapy²³. Alike, Ishikawa *et al* reported taste sensation affection in 44% of patients receiving chemotherapy and appetite loss in 87%²⁴.

Previous studies revealed that patients with cancer experience numerous symptoms, which commonly affect their food intake and many of them may start at the same time²⁵. Subsequently, we have expected weight loss and reduced BMI in patients experienced chemosensory symptoms that have been proven in our results. In our study, taste alteration was significantly associated with decreased BMI ($p=0.001$), whereas taste alteration for more than one week greatly affected nutritional intake and accordingly resulted in reduction of the BMI ($p=0.001$) calculated at the end of chemotherapy. On the other hand, BMI wasn't significantly affected by nausea and vomiting.

Table 5: Gastrointestinal problems and dietary intake before, during and after the course of chemotherapy.

Variables	1 st assessment (before the 1 st cycle)		2 nd assessment (after the mid-cycle)		3 rd assessment (after the last cycle)	
	No.	%	No.	%	No.	%
Decreased appetite						
No	60	100	13	21.7	11	18
Yes	0	0	47	78.3	49	81
< 1 week	0	0	29	48.3	33	51.7
> 1 week	0	0	18	30	16	26.7
Taste alteration						
No	60	100	22	36.6	10	16.7
Yes	0	0	44	73.3	50	83.3
< 1 week	0	0	10	13.6	5	10
> 1 week	0	0	34	59.7	45	90
Vomiting (> grade 2)						
No	60	100	31	51.6	44	73.4
Yes	0	0	29	48.4	16	26.6
Nausea (> grade 2)						
No	60	100	23	38.3	40	66.7
Yes	0	0	37	61.7	20	33.3
Meals intake						
Regular	50	83.3	14	23.3	10	16.7
Irregular	10	16.7	46	76.6	50	83.3
Number of daily meals						
1 – 2	9	15	39	65	42	70
3	51	85	19	31.7	16	26.7
When hungry	0	0	2	3.3	2	3.3

Moreover, most of the chemotherapy cycles contained taxane as part of the chemotherapy course, which was previously accused to alter taste sensation²⁶. In 2009 Steinbach and colleagues studied taste and smell changes in patients with breast and gynecologic cancer receiving chemotherapy. They found that taste and smell are significantly affected by chemotherapy, which resulted in reduced appetite and weight loss. And Taxane-based chemotherapy caused the most severe disorders²⁶. Furthermore, Speck *et al* evaluated the effect of taxanes on patients received docetaxel or paclitaxel and reported taste alteration as the most common side effect from taxanes²⁷.

Our study was limited by the small number of patients and the short follow up of the weight gain after chemotherapy.

RECOMMENDATIONS

Based on our findings, the nutritional assessment of breast cancer patients should be carried out prior to chemotherapy. Attention towards nutritional problems related to chemotherapy is needed. To prevent massive weight loss, patients should maintain adequate energy

intake during the course of chemotherapy. Besides, a long-term follow-up of weight changes after the end of the course of chemotherapy is also recommended.

Future research on larger number of patients with longer follow up is required to assess the nutritional status of patients receiving chemotherapy for breast cancer to avoid nutritional deficiency.

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Table 6: Correlation between selected variables and the change in body mass index (BMI).

Variable	Change in BMI (kg/m ²)		p value
	Mean	SD	
Altered taste (2nd assessment)			
Yes	- 3.39	2.78	<0.001
No	4.46	1.65	
Altered taste duration (2nd assessment)			
0	4.46	1.65	<0.001
< 1 week	- 3.16	2.85	
≥ 1 week	- 3.85	2.68	
Altered taste (3rd assessment)			
Yes	- 3.39	2.78	<0.001
No	4.46	1.65	
Altered taste duration (3rd assessment)			
0	4.46	1.65	<0.001
< 1 week	- 3.1	2.97	
≥ 1 week	- 3.84	2.48	
Decreased appetite (2nd assessment)			
Yes	- 3.83	2.19	<0.001
No	4.25	1.64	
Decreased appetite duration (2nd assessment)			
0	4.25	1.64	<0.001
< 1 week	- 3.57	2.66	
≥ 1 week	- 4.25	0.99	
Decreased appetite (3rd assessment)			
Yes	- 3.83	2.19	<0.001
No	4.25	1.64	
Decreased appetite duration (3rd assessment)			
0	4.25	1.64	<0.001
< 1 week	- 3.52	2.58	
≥ 1 week	- 4.44	0.9	
Acute nausea (2nd assessment)			
Yes	- 2.53	3.41	0.264
No	- 1.36	4.67	
Delayed nausea (2nd assessment)			
Yes	- 1.52	4.13	0.118
No	- 3.21	3.36	
Vomiting (2nd assessment)			
Yes	- 2.56	3.82	0.337
No	- 1.57	4.07	
Vomiting (3rd assessment)			
Yes	- 3.17	3.49	0.202
No	- 1.69	4.06	
	Pearson's correlation		p value
Vomiting frequency (2nd assessment)	- 0.087		0.511
Vomiting frequency (3rd assessment)	- 0.229		0.079

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