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Evaluation of malnutrition status in pediatric patients with gastrointestinal hematological tumors

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Abstract: Malnutrition is a potentially serious condition. Pediatric malignancies account for between 1% and 3% of diagnosed worldwide. The prevalence of malnutrition among such patients varies from 10% to 50%. This study conducted to investigate nutritional status of pediatric oncology undergoing chemo and/or radiotherapy. A cross sectional study conducted on 42 outpatient children. They divided into three groups; chemotherapy group (CG), radiotherapy group (RG) and chemoradiotherapy group (CRG). The evaluation was done at preceding therapy (PT) and after the first month of treatment, in the first chemotherapy and /or radiotherapy cycle of the induction therapy. All patients were subjected to assess the nutritional status according to Gomez classification. Blood and renal profiles, also hepatic enzymes were detected. Dietary intake was assessed using 24-hour dietary recalls. The results found their majority were having chemoradiotherapy (40%), Hepatocellular carcinoma has been the largest type (40%) among study population. According to Gomez classification, CG and CRG and were categorized in grade 2 malnutrition, while RG located in mild malnutrition in grade 1. Regarding the albumin level, all treated patients were categorized in moderate malnutrition. Total energy was dramatically decreased ($p \leq 0.05$), in particular CG (744±46 kcal/day). Also, dietary protein was severely diminished among all therapeutic modalities in particular CRG (4.70±0.94 g/day). Most of energy intake depends on dietary fat and carbohydrates. In conclusion: CG and CRG were categorized in

moderate malnutrition, while RG located in mild malnutrition. Total energy was dramatically declined; the protein intake was decreased significantly by half to three-quarters from RDA.

Keywords: gastrointestinal tumors, pediatric, malnutrition, gomez classification, albumin, nutrient intake.

Introduction

Patients with gastrointestinal cancer are especially vulnerable to malnutrition due to the peculiarities inherent to the disease (**Wu *et al.*, 2009**). This type of cancer presents important effects on the digestive system, such as changes in intestinal transit, untreatable vomiting and early satiety, which act directly on the process of digestion and absorption of food. Malnutrition is a potentially serious condition often comorbid with cancer and its treatment (**Prado and Campos, 2015**). An estimated incidence of malnutrition in cancer patients has been reported to range from approximately 10% to 80% and malnutrition itself was one of the reasons for death in up to 20% of cancer patients (**Koom *et al.*, 2012**).

Pediatric malignancies account for between 1% and 3% of cancer diagnosed worldwide. The prevalence of malnutrition among these patients varies from 10% to 50% (**SEER, 2012**), which negatively affects patients' response to therapy; increases the incidence of treatment-related side effects and can decrease survival. About 1,250 children younger than 15 years old are expected to die from cancer in 2015 (**Davies, 2005**).

Children are at greater risk for malnutrition due to increased needs of nutrients to obtain appropriate growth, and they exhibit elevated substrate needs due to cancer and its treatment (**İlhan *et al.*, 2015**). Also, patients receiving radiotherapy and chemotherapy often have a compromised nutritional status preceding and during treatment (**Cacicedo *et al.*, 2012**).

In terms of reducing morbidity and mortality, early diagnosis of malnutrition in pediatric patients are just as important as the planned treatment for disease, a study conducted to evaluate nutritional status of pediatric oncology at initial screening and undergoing Chemo and/or radiotherapy.

Patients and Methods

Patients: a cross sectional study conducted on 42 outpatient children, age 4 to ٧ years old admitted with a confirmed diagnosis of hematological tumors at the pediatric oncology center, Naser Institute Hospital, Cairo, Egypt, setting between March 2012 up to December 2013. Children were suffering

from one or two categorized phase of gastrointestinal tumors, all of them had approximately the same chemo and/or radiotherapy after surgery of tumor, histolopathological type of tumor was whether adenocarcinoma or mucoid carcinoma.

The exclusion criteria were previous chemotherapy or radiotherapy; infusion of blood products in the 30 days prior to data collection; patients in intensive care or those with comorbidities of chronic diseases (e.g., human immunodeficiency virus and disseminated tuberculosis), those with large solid abdominal masses or had lymph node metastasis that may present with normal weight despite severe malnutrition. The final sample was made up of 30 children, as 12 (28.6%) were not included for fulfilling one or more of the exclusion criteria during the experimental period.

Ethical consideration

Approval for the study was granted by administrator of the hospital. Informed consent was obtained from the parents of each patient.

Concurrent chemoradiotherapy

The daily fractional dose of radiation was 2Gy given five days a week; thus, the Patients received a total radiation dose of 56-60 Gy in 28-30 fractions using three-dimensional conformal radiotherapy technique (3D-CRT).

All patients received concurrent chemotherapy consisting of two cycles' cisplatin and 5-fluorouracil, which were administered on the first week and fourth week during the radiotherapy course. Fluorouracil (500 mg/m^2) was administered as continuous intravenous infusion on d1-5 (day) and d29-33. Cisplatin (30 mg/m^2) was given on d1-3 and d29-31.

If Grade 3/4 myloesuppression, or body temperature of 38.0^{o}C or more and any other life-threatening toxicities were observed, administration of chemoradiotherapy was discontinued until recovery from toxicity.

Children with inclusion criteria that starting chemotherapy and/or radiotherapy in the study setting, enrolled in the study were divided into three groups according to their standard medical treatment as follows; chemotherapy group (CG), radiotherapy group (RG) and chemoradiotherapy group (CRG). The evaluation was done at preceding therapy (PT) and after the first month of treatment, in the first chemotherapy and /or radiotherapy cycle of the induction therapy.

All patients were subjected to assess the nutritional status by the following anthropometric indices: body weight (kg) and height (m), BMI (kg/m^2). The parent/guardian was supplied data on habitual weight (HW) for the calculation of the percentage of weight loss (WL%) using the

following formula: WL (%) = (HW-current weight)/HW x 100 **(Kułaga *et al.*, 2013)**.

The degree of wasting growth (acute malnutrition) was estimated according to Gomez classification **(Gómez *et al.*, 1956)**, using the following formula: (Actual weight (kg)/ Ideal Body Weight (IBW kg) × 100. IBW (50^{th} percentile for weight for age) was estimated using CDC growth charts weight for age percentiles from 2 to 20 years. Gomez categories were 76-90% of theoretical weight for age for first degree of malnutrition (mild); 61-75% of theoretical weight for age for second degree of malnutrition (moderate); and ≤60% of theoretical weight for age for third degree of malnutrition (severe), **(Suskind and Lenssen, 2011)**.

Blood samples were collected from patients during attending the out patients clinic at the start and the end of the study (3 months). The following parameters were estimated, hemoglobin (Hgb g/dl) and red blood cells (RBCs) count (cells /mm^3) were determined according to the method described by **Dacie and Lewis, (1998),** white blood cells (WBCs) count and differential leucocytes (neutrophils and T lymphocytes (TLC%) were assessed according to the method described of **Schermer, (1967),** AST and ALT activities were measured according to the method described by **Thefeld (1974),** albumin and creatinine were analyzed using the colorimetric method with spectrophotometer (Jonway, UK) according to the method described by **Henry, (1974)**. The following cutoff points for albumin were used for references values of nutritional status: >3.5 (g/dL) acceptable, 2.8-3.4 (g/dL) mild malnutrition, 2.1-2.7 (g/dL) moderate malnutrition; and < 2.1 (g/dL) severe malnutrition.

Dietary intake was assessed using 24-hour dietary recalls for three days (two week day and one week end) for each at preceding therapy and after first month of treatment. The 24-hour dietary recalls was carried out through interview with the parent/guardian, each interview lasted 15 to 20 minutes. Nutritive value of the consumed foods was evaluated using computerized software Nutritionist Program **(FACP, 1995)**. The adequacies of energy and macro/micronutrients were determined using the dietary reference intake **(DRI, 2002)**.

Statistical analysis: The data were analyzed using a completely randomized factorial design when a significant main effect was detected. The means were separated with the Student-Newman-Keuls Test. Differences between treatments at P≤0.05 were considered significant using Costat Program **(SAS, 1988)**. Biological results were analyzed by One Way ANOVA and LSD.

Results

The treatment modalities of studied children are displayed in Figure (1). The majority of children were having chemoradiotherapy (40%) and 36.66% were treated by chemotherapy while the least portion (23.33%) was followed circulated the sessions of radiotherapy, the majority of whom were boys (60%) and girls represent 40%.

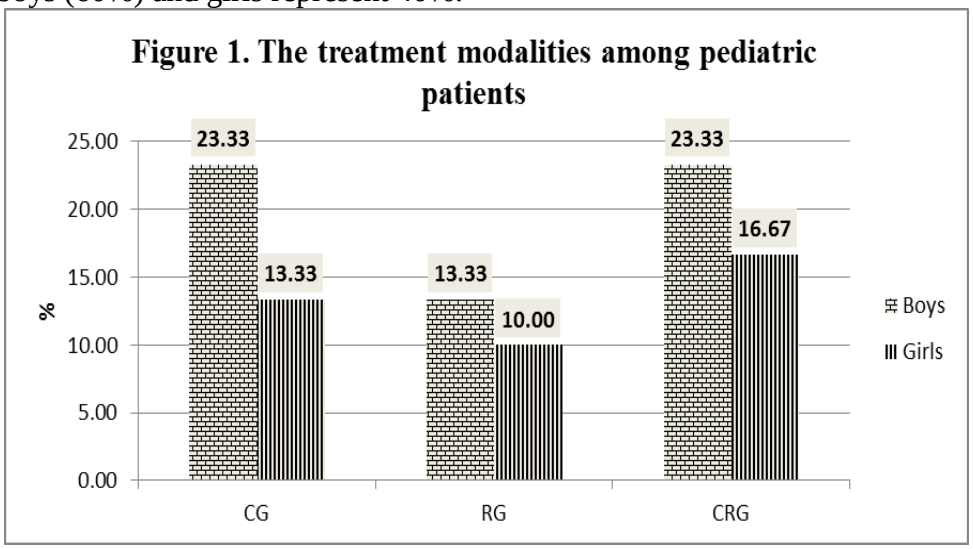

Figure 1. The treatment modalities among pediatric patients

Figure (2) clarifies the prevalence rate of gastrointestinal carcinoma among studied patients. Hepatocellular carcinoma has been the largest type (40%) among infected children, and 20% of them were treated with CRT. Also, adenocarcinoma gastric cancer was indicated by higher portion (33.34%), and 16.67% from them were in RT. Familial adenomatous polyposis was detected by 13.33% and esophageal squamous cell carcinoma was incidence by 10.03%.

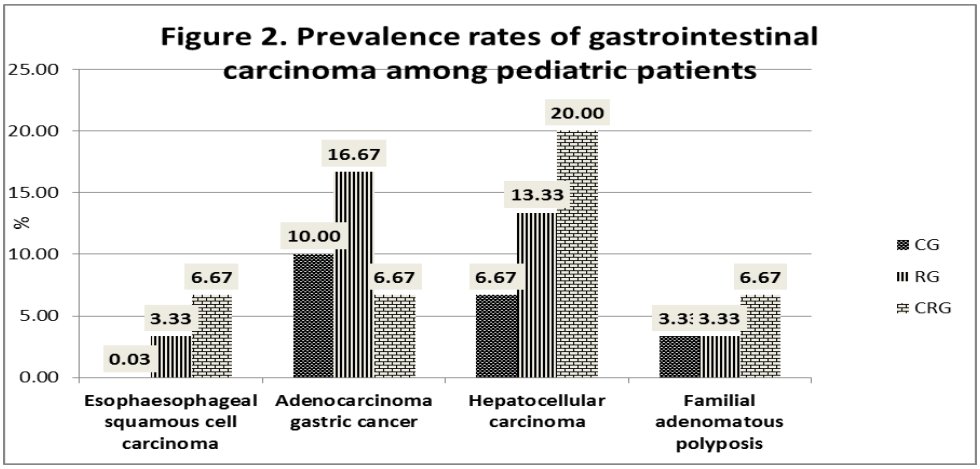

Figure (3) demonstrates the most common complications of therapeutic modalities, dysgeusia and xerostomia were the highest symptom after therapeutic modalities by 26.67%, followed by vomiting and fever (23.33%) in CRG. Also, anemia and melena were at equal portions (6.6%) in CG and RG and elevated in CRG (16.67%). In addition all patients were complained from diarrhea and/or constipation at equal portions.

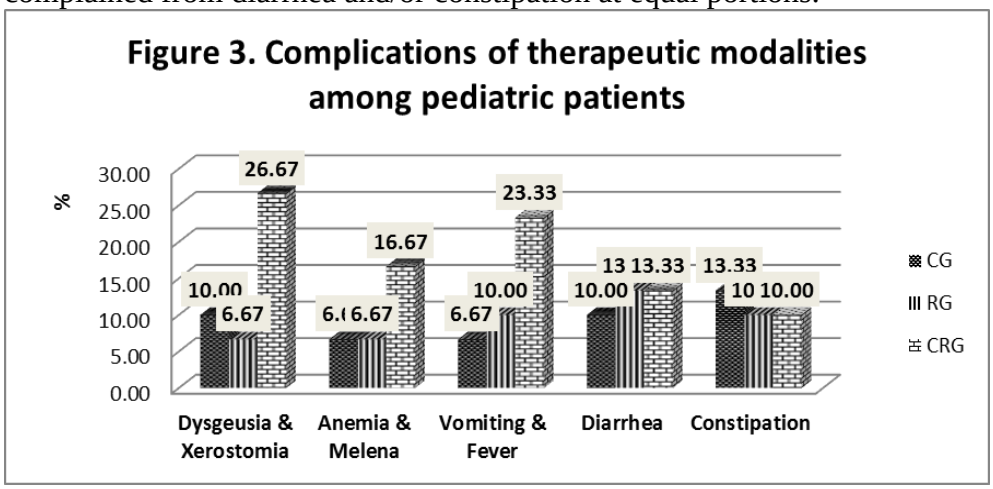

Table (1) illustrated the anthropometric measurements and Gomez classification of malnutrition status of pediatric patients. The dominant feature of body weight is a great significant decrease in particularly CRG

group (12.01±1.61 kg), and it is reflected in weight loss by 22.51±5.61% compared to other groups that did not differ significantly at p ≤0.05. All groups were located under threshold of under nutrition according to BMI-WHO.

According to Gomez classification, CG and CRG did not differ significantly (70.35±3.89 versus 63.44±4.06%, respectively) and were categorized in grade 2 undergoing moderate malnutrition, while RG located in mild malnutrition grade 1.

Table (1): Gomez classification of malnutrition among pediatric patients with gastrointestinal hematological tumors after therapeutic modalities

	PT	Treated groups after the first month of the induction cycle therapy			LSD
		CG	RG	CRG	
Height (cm)	0.97±0.06^{b}	1.02±0.09^{ab}	1.07±0.06^{a}	0.95±0.04^{b}	0.062
Weight (Kg)	15.24±1.88^{a}	14.83±2.34^{a}	14.87±1.51^{a}	12.01±1.61^{b}	1.768
BMI (Kg/m^2)	16.32±0.95^{a}	12.77±0.88^{b}	12.68±0.33^{b}	11.96±0.34^{b}	0.967
WL%	17.29±5.19^{b}	15.09±6.71^{b}	16.11±3.56^{b}	22.51±5.61^{a}	4.963
Gomez (WFA)	77.62±9.04^{a}	70.35±3.89^{ab}	78.49±11.92^{a}	63.44±4.06^{b}	7.110

PT: preceding therapy; **CG**: Chemotherapy group; **RG**: Radiotherapy group; **CRG**: Chemoradiotherapy group; **BMI**: Body mass index; **WL**: weight loss; **WFA**: weight for age

As illustrated in table (2), both CG and CRG were decreased significantly (p ≤0.05) in RBCs and hemoglobin levels (3.40±0.47 and 8.93±0.82 versus 3.20±0.53 and 8.31±0.81, respectively) which refers to the risk of anemia. For leukocytes differentiate, the extreme imbalance was indicated particularly in CRG that decreased significantly 3.63±0.98, 15.87±1.68 and 12.98±2.98 for WBCs, neutrophils and TLC% respectively, while there is non-significant change between CG and RG.

Table (2): Blood profiles of pediatric patients with gastrointestinal hematological tumors after therapeutic modalities

	PT	Treated groups after the first month of the induction cycle therapy			LSD
		CG	RG	CRG	
RBCs ($\times10^{12}$/L)	4.50±0.35[a]	3.40±0.47[b]	4.35±0.46[a]	3.20±0.53[b]	0.442
Hgb (g/dl)	11.96±0.58[a]	8.93±0.82[b]	11.59±0.44[a]	8.31±0.81[c]	0.606
WBCs ($\times10^{9}$/L)	17.51±1.61[a]	8.50±1.90[b]	7.15±1.47[b]	3.63±0.98[c]	1.390
Neutrophils %	69.55±12.71[a]	37.68±3.31[b]	40.93±4.41[b]	15.87±1.68[c]	6.312
TLC%	82.76±10.35[a]	39.46±6.25[b]	36.05±5.51[b]	12.98±2.98[c]	6.668

PT: preceding therapy; **CG**: Chemotherapy group; **RG**: Radiotherapy group; **CRG**: Chemoradiotherapy group, **LSD**: Least significant of difference, **RBCs**: Red blood cells, **Hgb**: Heamoglobin, **WBCs**: White blood cells, **TLC%**: Total Lymphocyte count

Concerning to hepatic enzymes (table 3), AST was decreased at light extent, and ALT was differed significantly ($p \leq 0.05$) in RG (54.40±6.07 mg/dl) than other groups by 46.34±4.01 and 46.26±5.33 mg/dl for CG and CRG, respectively. The use of albumin parameter adjunct to anthropometric measurements increased the sensitivity of malnutrition criteria. Regarding the albumin level, all treated patients were categorized in moderate malnutrition. Albumin was decreased significantly in CG and CRG (2.24±0.08 and 2.25±0.09 g/dL), respectively. For creatinine, it was declined significantly ($p \leq 0.05$) after treatment in particular CG 0.38±0.06 mg/dl.

Table (3): Hepatic and renal profiles of pediatric patients with gastrointestinal hematological tumors after therapeutic modalities

	PT	**CG**	**RG**	**CRG**	**LSD**
AST (U/L)	48.20±4.36[a]	45.57±2.92[a]	46.80±4.63[a]	45.35±5.73[a]	3.786
ALT (U/L)	50.50±4.27[ab]	46.34±4.01[b]	54.40±6.07[a]	46.26±5.33[b]	4.997
Albumin(g/dl)	2.64±0.22[a]	2.24±0.08[c]	2.44±0.18[b]	2.25±0.09[c]	0.136
Creatinine(mg/dl)	0.58±0.03[a]	0.38±0.06[c]	0.54±0.05[a]	0.43±0.05[b]	0.047

PT: preceding therapy; **CG**: Chemotherapy group; **RG**: Radiotherapy group; **CRG**: Chemoradiotherapy group, **LSD**: Least significant of difference, **AST**: Aspartate aminotransferase, **ALT:** Alanine Aminotransferase.

Regarding to nutrient intake, total energy was dramatically and significantly decreased ($p \leq 0.05$), in particular CG (744.63±46.59 kcal/day) compared to preceding treatment (912±9.85 kcal/day). Also, dietary protein was severely diminished among all therapeutic modalities in particular CRG 4.70±0.94 g/day, the protein intake was decreased significantly by half to three-quarters from RDA. Most of energy intake depends on dietary fat and carbohydrates. Fat intake was increased above RDA by 20.56 at preceding therapy and 10% after treatment in CRG. The reduction of fiber intake ranged from -79.60 to -85.16 in CG and CRG, respectively.

Table (4): Macronutrients intake pediatric patients withgastrointestinal hematological tumors after therapeutic modalities

Nutrients	DRI*	PT	CG	RG	CRG	LSD
Energy	1742 for males 1642 for female ~ 1692 kcal/day	912±9.85[a]	744±46.59[c]	818±9.52[b]	792±22.06[b]	30.561
% change		-46.05	-55.99	-51.64	-53.15	
Total Protein	19 g/day	9.39±1.11[a]	6.23±1.33[b]	6.75±0.74[b]	4.70±0.94[c]	1.431
% change		-50.58	-67.21	-64.47	-75.26	
Total Fat	30 g/day	36.47±0.55[a]	29.54±1.38[c]	32.87±1.89[b]	33.56±2.19[b]	2.144
% change		20.56	1.53	9.56	10	
Carbohydrates	130g/day	136.74±1.98[a]	113.45±8.03[c]	123.90±4.63[b]	117.94±3.78[bc]	6.155
% change		5.18	-13.07	- 4.68	-9.27	
Fiber	25 g/day	5.31±1.80[a]	5.10±0.77[a]	4.36±1.14[a]	3.71±0.34[a]	1.681
% change		-78.76	-79.60	-82.56	-85.16	

Adopted from (Institute of Medicine of The National Academies): Dietary reference intakes for energy, carbohydrates, fiber, fat, protein, Washington, DC, 2O02/2005, **(National Academic Press, 2005)**.

Regarding minerals and vitamin intake from Table (5), non-significant was observed among the treatment groups for dietary calcium intake that was decreased in CRG by 36.47% from RDA. The patients were at risk of anemia attributed to iron deficiency either before or after treatment and it reached ultimately at level 4.12±0.08 in CRG. It follows that, all vitamins intake was depleted significantly among studied children in

particular CRG by -58.52, -76.6, -31.28 and -50.83 for Vitamin C, D, E and B12, respectively.

Table (5): Minerals and Vitamin intake among pediatric patients with gastrointestinal hematological tumors after therapeutic modalities

	DRI*	PT	CG	RG	CRG	LSD
Ca	800 mg/d	601.13±58.57[a]	569.50±45.75[ab]	561.53±50.35[ab]	508.20±16.73[b]	56.683
% change		-24.85	-28.81	-29.80	-36.47	
Fe	10 mg/d	6.63±0.27[a]	6.43±0.35[a]	6.60±0.82[a]	4.12±0.08[b]	0.693
% change		-33.70	-35.70	-34	-58.80	
Vit. C	25 mg/d	19.00±1.65[a]	19.10±0.72[a]	17.41±0.62[a]	10.37±1.19[b]	1.387
% change		-24	-23.60	-30.36	-58.52	
Vit. D	5 µg/d	1.59±0.04[a]	1.60±0.08[a]	1.76±0.14[a]	1.17±0.10[b]	0.152
% change		-68.20	-68	-64.8	-76.6	
Vit. E	7 mg/d	6.10±0.31[a]	5.38±0.40[b]	5.65±0.20[b]	4.81±0.24[c]	0.444
% change		-12.85	-23.14	-19.28	-31.28	
Vit. B12	1.2 µg/d	1.01±0.05[a]	0.8±0.025[b]	0.83±0.05[b]	0.59±0.041[c]	0.065
% change		-15.83	-33.33	-30.83	-50.83	

Adapted from the Dietary Reference Intake (DRIs) series, **(National Academic press, 2005)**.

Discussion

The current study involved the children suffering from various types of gastrointestinal tumors. About two thirds of them were boys, a finding that goes in line with **Khalil *et al.*, (2013)**, who reported higher frequency of cancer among males compared with females. Concerning the treatment modalities, the majority of the children in the present study were treated by chemotherapy with or without radiotherapy. This result is in congruence with the known fact that chemotherapy is the most frequently used treatment modality in pediatric oncology with or without radiotherapy (**Sala *et al.*, 2004**). Moreover, it is unique because it is effective, for systemic cancers that cannot be managed by surgery or radiation (**Potts and Mandleco, 2007**).

As described from the complaint of the patients, the most common symptoms are anorexia, xerostomia, dysgeusia, nausea, vomiting, constipation/or diarrhea and fever. These symptoms may occur with the initiation of gastrointestinal irradiation and may persist throughout

chemotherapy as the same illustrated by (**Lee and lee, 2015**), thus resulting a negatively affect the nutritional status by decrease food intake and extreme weight loss and malnutrition (**Pérez Camargo *et al.*, 2013**).

Concerning the anthropometric measurements of the current studied children, the results demonstrated that plurality of them had abnormal weight below the normal levels for their age. Cancer patients can be affected by malnutrition at the onset of the disease, as well as during treatment due to treatment toxicity, weight loss during treatment not only increases the risk of adverse outcomes, but also, may interrupt the treatment, which compromises tumor control as mentioned by **Morton *et al.*, (2009**).

In the present study, patients who underwent chemotherapy had a significant weight loss during radiotherapy and even greater weight loss after one month treatment. This observation lead us to consider chemotherapy a major risk factor influencing weight loss as confirmed by the findings of **Cacicedo *et al.*, (2014)**. It is known that the use of chemoradiotherapy produces a radiosensitization effect that leads to increased acute toxicity. **Guo *et al.*, (2010)** mentioned that the patients who underwent chemotherapy lost more weight further substantiates that chemoradiotherapy can be intensive and can be associated with severe acute toxicity, especially in patients with gastrointestinal tumors.

Also, present data revealed that more than two-thirds of the studied children had the risk for anemia based on measurement of their RBCs and hemoglobin level. **Burns *et al.*, (2009**) speculated that anemia in children with cancer has multiple etiologies, infection, the occurrence of bleeding arising from the neoplasias (**Prado and Campos, 2015**), in addition to the factors of iron and folic acid deficiencies. Moreover, whole abdominal irradiation may result in a low normal level of blood radioactivity and the effects of chemotherapy are probably the leading nutritional causes of anemia. Additionally, the current study revealed that majority of the studied children had abnormally low levels of serum albumin an indicator of late malnutrition; these findings are in harmony with those of **Gürlek Gökçebay *et al.*, (2015**) who found that serum albumin levels of the all subjects were below normal ranges in patients who were malnourished.

Regarding to nutritional status, the findings showed that total energy was dramatically decreased among treated groups compared to preceding treatment. The present study findings are in harmony with those of **Inger *et al.*, (2002)** who found that children with cancer had an average daily energy intake below recommended and negative weight development after the start of chemotherapy. the same trend was found in the results of **Valenzuela-Landaeta *et al.*, (2012)** who demonstrated that lean and fat mass depletion in children with cancer is generally progressive, leading to severe malnutrition and characterizing cachexia that alter the metabolism of carbohydrates, proteins and fats, leading to growth failure in childhood cancer (**Garófalo *et al.*, 2005**).

Current results indicated that wasting was identified after treatment modalities in particular CRG. In this aspect, **Bechard *et al.*, (2006)** evidenced that energy deficits play an important role in the progress of the wasting syndrome in children related to: increased nutrient requirements; increased metabolic rate **(Brinksma *et al.*, 2012)**; energy losses caused by frequent gastrointestinal dysfunction due to cancer therapy induced toxicity; an excess utilization of energy sources as a result of aggressive multimodal cancer treatments; metabolic and hormonal alterations; uncontrolled pain or stress from inevitable procedures; and disorders in appetite sensation or changes in taste (e.g. due to xerostomia). Furthermore, **Tisdale, (2002)** suggested that the use of muscle-derived proteins for gluconeogenesis contributes to an additional loss of energy and for a further increase in energy expenditure, resulting in a catabolic state.

Protein disturbances comprise an increased whole body protein turnover, likely mediated a reduction in muscle protein synthesis as reviewed by **Tisdale, (2009),** it was explicated a multifactorial pathophysiological mechanisms contribute to the development of malnutrition including, complex interactions between energy and substrate metabolism; hormonal and inflammatory components; and alterations of metabolic compartments. Also radiotherapy induced catabolic factors such as tumor necrosis factor α (TNF-α) and interleukins. These result in accelerated mobilization catabolism, oxidation of energy substrates, and loss of body proteins. Also, accelerated lipolysis with increased production of

glycerol and free fatty acids contributes to the depletion of fat stores and subsequent weight loss (**Skipworth *et al.*, 2007**).

The findings of nutritional intake evidenced that suboptimal total vitamins and minerals was determined, that may be result of intense diarrhea, vomiting, mucositis, and systemic effects of therapy, in addition affected children often experience a prolonged period of minimal oral intake, this contributes to fluid loss, electrolyte and trace elements imbalance, and alterations of their carrier proteins, as well as iron and vitamin deficiency that may result in acute and chronic malabsorption of micro- and macronutrients as mentioned by **Bauer *et al.*, (2011).**

In accordance of these results, **Seo and Yoon, (2013)** demonstrated that Vitamin B intake are decreased in advanced cancer stage. Also, **İlhan *et al.*, (2015)** mentioned that pediatric cancer patients had lower levels of iron, folate, zinc, and vitamin C. Thus, **Gürlek Gökçebay *et al.*, (2015**) recommended that protein and energy dense oral nutritional supplements are effective for preventing weight loss in malnourished children receives intensive treatment of cancer.

Recommendations

Early diagnosis of malnutrition in cancer patients and nutritional intervention may increase tolerance to cancer treatment modalities and improve quality of life and prognosis.

Limitation

The sample of this study was from a single hospital with a relatively small number of patients. A multicenter study needed to be conducted in the future.

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تقييم حالة سوء التغذية للأطفال المرضى بأورام الجهاز الهضمي

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تعد سوء التغذية من الإضطرابات الحرجة. ولما كان معدل إصابة الأطفال بالأورام تتراوح من ١-٣% التي يتم تشخيصها عالمياً؛ فإنه يقدر المتعرضين منهم لسوء التغذية من ١٠ إلي ٥٠%. وقد تم إجراء الدراسة الحالية لتقصي الحالة التغذوية للخاضعين من هؤلاء الأطفال للعلاج سواء الكيماوي أو الإشعاعي أو كلاهما. وقد شملت الدراسة ٤٢ طفلاً؛ تم تقسيمهم لثلاث مجموعات دراسية: الأولي تخضع للعلاج الكيماوي، الثانية للإشعاعي والأخيرة لكلا العلاجين معا. هذا؛ وقد تم تعريف الأطفال وذويهم بمحتوي الدراسة وتم تقصي الحالة التغذوية وإجراء تحليل مؤشرات الدم ووظائف الكلي والكبد، حساب المأخوذ الغذائي علي مدار اليوم قبل وخلال الشهر الأول من خضوعهم للعلاج الطبي. ولقد أظهرت النتائج أن الغالبية العظمي من أورام الأطفال (٤٠%) يصابون بسرطان الكبد؛ وهو ما يدرج كخلل سوء تغذية بسيط حال خضوعه للعلاج الإشعاعي طبقا لتقسيم "جوميز" أو سوء تغذية متوسط في حالة العلاج الكيماوي أو الإشعاعي الكيماوي. وبمتابعة مستوى الألبيومين للأطفال موضع الدراسة تبين أنهم يعانون من سوء تغذية متوسط. وكانت هناك إنخفاض حاد ذا دلالة معنوية بمعدلات الطاقة خاصة للخاضعين للعلاج الكيماوي (46.59±744كيلو كالوري/اليوم). وأيضا؛ إنخفض بشدة محتوي البروتين التغذوي للمتلقين للعلاج المزدوج. بينما كان أغلب مصدر للطاقة لدي هؤلاء الأطفال يتمثل في الدهون والكربوهيدرات. في النهاية؛ تخلص الدراسة إلى أن الأطفال الخاضعين للعلاج المختلط "الكيماوي والإشعاعي" يتم تصنيفهم كمرضي سوء تغذية متوسط وفق تقسيم جوميز، والمتلقين للعلاج الإشعاعي بسوء التغذية البسيط (الحاد). وكذلك، تنخفض بشكل حاد معدلات الطاقة وينخفض البروتين من النصف للثلاث أرباع بدلالة إحصائية عالية.

الكلمات المفتاحية: أورام الجهاز الهضمي، أطفال، سوء التغذية، تقسيم جوميز، ألبيومين، المأخوذ الغذائي.