Effect of Designing Nursing Teaching Protocol on Patients Undergoing Chemotherapy to Minimize Complications of Neutropenia

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Abstract
Background Patients undergoing chemotherapy are at risk of developing neutropenia that may cause life-threatening infections and death. **Aim:** Evaluate effect of designing nursing teaching protocol on patients undergoing chemotherapy to minimize complications of neutropenia. **Design:** A Pre and Post test research design was utilized. **Sample**: sixty adult patients undergoing chemotherapy both males and females. **Setting:** The study was carried out in the internal medical oncology departments and intensive care unit at South Egypt Cancer Institute. **Tools:** An interview questionnaire sheet for the patient, A designed nursing teaching protocol for patients undergoing chemotherapy to minimize complications of neutropenia and patient`s assessment sheet for complications of neutropenia. **Results:** There were highly statistically significant differences between "pre and post" application of the designed nursing teaching protocol in both all knowledge items and complications of neutropenia P<0.001. **Conclusion:** there were highly statistically significant differences between studied patients "pre and post" application of the designed nursing teaching protocol regarding total knowledge and complications of neutropenia. **Recommendation:** Tangible tools and education of patients, families and healthcare workers are keys to speedy recognition of potentially life-threatening symptoms associated with neutropenia.

Keywords: Chemotherapy, Complications, Neutropenia & Nursing Teaching Protocol.

Introduction
Patients undergoing myelo-suppressive chemotherapy are at risk of developing neutropenia that meant as an absolute neutrophil count less than 500/mm^3, a problem which may lead to life-threatening infections that may quickly lead to sepsis and death. (**Hawley et al., 2011) & (Hashiguchi et al., 2015)**

The febrile neutropenia (FN) consider the main common cause of morbidity, so immediate treatment and dose reduction in patients undergoing chemotherapy is very important. (**Weycker et al., 2014) & (Supportive & Board 2016).**

A decrease of elements of the immune system in many patients experience cancer that make them more susceptible to many infections as regarding to the kind and intensity of chemotherapy received and other risk factors. Neutropenia considered an oncology emergency and can cause adverse consequences such as serious infection complications and death. (**Villafuerte et al., 2014) & (Rasmy et al., 2016).**

Therapeutic treatment is very important to enhance the immune-deficient body target an active infection efficiently. When febrile neutropenia occurs, it is important to initial treatment with broad-spectrum antibiotics by hospitalize patient as fast as possible provide rapidly management. Until the neutrophils count return to the normal level, the patients should kept under close observation. **(Lustberg., 2012)**

Oncology nurses should identify patients at risk for developing neutropenia and monitor patients who already have abnormal neutrophil counts for better initiation of interventions to enhance patients' management with cancer receiving chemotherapy**. (Ropka & Padilla, 2007) & (Teleb & Mohamed, 2016)**

Significance of the study
From the researchers observation that patient's knowledge about neutropenia was inadequate and patients are in need to know more about neutropenia and its effect that may be life-threatening infections, sepsis and death. About (4300) new cases according to South Egypt Cancer Institute record in a year of (2017), therefor this study considered the first, which produced an outline to nursing care for patients undergoing chemotherapy to minimize complications of neutropenia in a form of designed nursing teaching protocol that can have the effect on life and death in this geographical location.

Aim of the study

To evaluate effect of designing nursing teaching protocol on patients undergoing chemotherapy to minimize complications of neutropenia through the following:

1. Assess patient`s knowledge about neutropenia.
2. Design a nursing teaching protocol for patients undergoing chemotherapy and have neutropenia.
3. Evaluate effect of designing nursing teaching protocol among the patients undergoing chemotherapy minimizing complications of neutropenia**.**

Subjects & Methods

Research design

We used in this study Pre & Post test of research design.

Setting

At South Egypt Cancer Institute the study was conducted in internal medical oncology department and intensive care unit.

Variables

- The independent variable is the designed nursing teaching protocol.
- Patient`s knowledge and neutropenia complications considered the dependent variables

Subjects

The study sample (convenient sample) consisted of sixty adult patients, mean age ranged between (18-65) years, both males and females undergoing chemotherapy and consented to participate in the study. Study period four months from December, 2016 to April, 2017.

Study tools

Tool (I): An interview questionnaire sheet, it included three parts

Part (1): Demographic and medical data:

The researchers formed this part based on literature review by the researchers and it included the following**:**

- Patients' demographic data: included age, sex, level of education, marital status, type of employment, residence and smoking).
- Medical data about patients which include of type of cancer, stage of cancer, presence of chronic illness, medication use and investigation of the studied patients. These are client-related risk factors for developing neutropenia.

Part (2): ECOG performance status

It was developed by the Eastern Cooperative Oncology Group **Oken et al., (1982)**. It described a patient's functioning levels in terms of their ability to care for them self, daily activity, and physical ability. It was contained 6 grades classified as following:

Grade (0)	Fully active, able to carry on all pre-disease performance without restriction,
Grade (1)	Restricted in physically strenuous activity but ambulatory and able to carry out work of a light or sedentary nature, light house work, office work.
Grade (2)	Ambulatory and capable of all self care but unable to carry out any work activities; up and about more than 50% of waking hours.
Grade (3)	Capable of only limited self care; confined to bed or chair more than 50% of waking hours.
Grade (4)	Completely disabled; cannot carry on any self care; totally confined to bed or chair.
Grade (5)	Death

Part (3-A): Patients' knowledge about neutropenia

Based on national and international literature to identify patients` knowledge about neutropenia, it was formed by the researchers. It included 12 multiple choices questions for assessing the patient`s knowledge level on the prevention of neutropenia containing information about white blood cells, prevention of infection in environmental factors, dietary factors, personal hygiene, and management of neutropenic infection. These questions were developed related to the content of the education program.

Scoring system

Total number of questions was twelve, each question contained five responses (from A to E), and the patient chooses the answer. The total score of patients' knowledge questionnaire sheet was 60 degrees:

- More than 50% means satisfactory.
- Less than 50% means unsatisfactory.

Part (3-B): Designed nursing teaching protocol

The researchers developed this protocol based on patient's knowledge assessment and after current national and international literature reviewing. It aimed to supply the patients with adequate knowledge about neutropenia care; introduction, definition, causes, signs and symptoms, diagnostic studies, medical management of neutropenia and the designed nursing teaching protocol for neutropenia patients.

Tool (II): Patient's complications assessment sheet:

This sheet aimed to assess complications of patients undergoing chemotherapy and complains from

neutropenia pre and after applying of the designed nursing teaching protocol.

It consists two main parts

Part (1): Scale for grades severity of neutropenia (According to National Cancer Institute **(NCI, 2010)**

It consisted of the level score of severity of neutropenia and febrile neutropenia from grade (**1 to 5**);

Grade (1)	Mild, with mild or no symptoms and no interventions required when (Neutrophils less than lower limit of normal to 1500/mm^3),
Grade (2)	Moderate; minimal intervention indicated and some limitation of activities when (Neutrophils less than 1500/mm^3 to 1000/mm^3),
Grade (3)	Severe but not life threatening; hospitalization required and limitation of patient's ability to care for him/herself when (Neutrophils less than 1500/mm^3 to 1000/mm^3),
Grade (4)	Life threatening; urgent intervention required when (Neutrophils less than 500/mm^3) and
Grade (5)	Death related to adverse event.

Part (2): The complication's assessment sheet: According to Common Terminology Criteria for Adverse Events (CTCAE) Version 4.0, (2010)

Infections and infestations					
Grade					
Adverse Event	**1**	**2**	**3**	**4**	**5**
Abdominal infection					
Anorectal infection					
Appendicitis					
Bladder infection					
Bronchial infection					
Catheter related infection					
Conjunctivitis infective					
Enterocolitis infectious					
Esophageal infection					
Eye infection					
Gallbladder infection					
Gum infection					
Lung infection					
Meningitis					
Mucosal infection					
Otitis media					
Pharyngitis					
Phlebitis infective					
Pleural infection					
Prostate infection					
Rash pustular					
Rhinitis infective					
Salivary gland infection					
Sepsis					
Sinusitis					
Skin infection					
Small intestine infection					
Soft tissue infection					
Stoma site infection					
Tooth infection					
Upper respiratory infection					
Urinary tract infection					
Uterine infection					
Vaginal infection					
Wound infection					
Infections and infestations - Other, specify					

Grade refers to the severity of the Adverse Event (AE). The CTCAE displays Grades 1 through 5 with unique clinical descriptions of severity for each AE based on this general guideline:

Grade (1): Mild; asymptomatic, intervention not indicated.

Grade (2): Moderate; local or noninvasive intervention indicated.

Grade(3): Severe or medically significant but not immediately life threatening; hospitalization or prolongation of hospitalization indicated.

Grade (4): Life-threatening consequences; urgent intervention indicated.

Grade (5): Death related to AE.

Ethical considerations

An official permission to conduct the study was acquired by the researchers from the South Egypt Cancer Institute' Dean. The reason of this research was explained for each patient. The researcher accentuated that the participation is deliberate also confidentially and anonymity of patients were achieved by coding all patient's data, and protection of the patient from hazard was achieved. A verbal

consent was acquired from every patient preceding his/her contribution in the present study. Confidentiality of any obtained information was secured.

Technique for data collection:

A review of current and past, local and international related literature in the various aspects of the problem using books, articles, periodicals, and magazines was done.

Content validity

Content validity was established by panel of 5 expertises: 3 teaching staff of Medical Surgical Nursing, Faculty of Nursing, at Assiut University, and 2 Lecturers of Medical Oncology in South Egypt Cancer Institute) who reviewed the tools of data collection for clarity, relevance, comprehensiveness, understanding, applicability and easiness, minor modifications are required.

Pilot study

A pilot study was carried out on 10% (n=6) of the sample in the selected setting to evaluate the applicability and clarity of the tools; those patients were included in the main study if no modification. It had also provided an estimation of the time needed to fill out the tools.

Procedure

Once permission was granted to proceed with the proposed study, the researcher initiated data collection.

- At initial interview, the researcher introduced herself to initiate communication.
- Verbal consent was obtained from each patient prior to his/her contribution in the present study.
- The researcher explained nature and purpose of the research to the selected patients who participated in the study.
- Each patient involved in the study was assessed for his /her knowledge pre test (tool I) after admission, the tools filled through interviewing. The study was carried out at morning, and at after noon shifts.
- The researcher assessed patients who participated in the study for complications of neutropenia (tool II).
- The application of the designed nursing teaching protocol (tool I) was performed by the researcher then by patients; the researcher prepared the teaching aids and media (pictures, handout). Each patient or his/her relatives obtained a copy of the designed nursing teaching protocol. Data were collected through the period from December, 2016 to April, 2017.
- Evaluate applying of the designed nursing teaching protocol on patient`s knowledge before discharge using (tool I). As well as the researcher filled the patient`s complications assessment sheet (tool II).

Statistical design

The data analysis was carried out using soft wear package computer program SPSS (version, 23) the collected data were tabulated and analyzed by using frequency, percentage, distribution, range and standard deviation. The level of statistically significant was considered at $p<0.05$. Independent T test, chi square were used to compare between pre and after applied of nursing teaching protocol regarded to investigation of studied patients.

Results

Table (1): Distribution of socio-demographic data for studied patients (n=60)

Variables	N.	%
Age by years:		
- 18<29	12	20.0
- 29<40	15	25.0
- 40<50	13	21.7
- 50 and more	20	33.3
Mean +SD	41.78+14.59	
Sex:		
- Male	21	35.0
- Female	39	65.0
Marital status:		
- Single	16	26.7
- Married	34	56.7
- Divorced	4	6.7
- Widowed	6	10.0
Level of education:		
- Illiterate	15	25.0
- Primary school	5	8.3

Variables	N.	%
- Secondary education	28	46.7
- bachelor's degree or above	12	20.0
Types of Employment :		
- Unemployed	42	70.0
- Employed	18	30.0
Type of residence:		
- Rural	49	81.7
- Urban	11	18.3
Smoking:		
- Smokers	7	11.7
- Non smokers	53	88.3

Table (2): Percentage distribution of the studied patients regarding their medical data (n=60).

Variables	N.	%
Type of cancer		
- Acute myeloid leukemia	21	35.0
- Cancer ovary	6	10.0
- Ewing's sarcoma	1	1.7
- Multiple myeloma	2	3.3
- Acute lymphatic leukemia	6	10.0
- large retroperitoneal mass	1	1.7
- Relapsed all	4	6.7
- Myeloid fibrosis	1	1.7
- Breast cancer	5	8.3
- Cancer colon	4	6.7
- Cancer lung	3	5.0
- NHL	4	6.7
- Cancer bladder	2	3.3
Stages of cancers		
- Stage 1	1	1.7
- Stage 2	1	1.7
- Stage 3	10	16.7
- Stage 4	13	21.7
Presence of chronic illness		
Liver disease		
- Yes	5	8.3
- No	55	91.7
Renal disease		
- Yes	1	1.7
- No	59	98.3
Cardiovascular disease		
- Yes	12	20.0
- No	48	80.0
Present of open wound		
- Yes	2	3.3
- No	58	96.7
Previous radiation therapy		
- Yes	-	-
- No	60	100.0
Medication used		

Variables	N.	%
Antibiotic		
- Yes	34	56.7
- No	26	43.3
Anti-fungal		
- Yes	28	46.6
- No	32	53.3
Antibiotic and anti-fungal		
- Yes	26	43.3
- No	34	56.7
G-CSF		
- Yes	35	58.3
- No	25	41.7

(*GCSF): Granulocyte colony stimulating factor*

Table (3): Percentage distribution for medical data of the studied patients regarding to ECOG performance status (n=60).

Variable	Grade 0		Grade 1		Grade 2		Grade 3		Grade 4		Grade5	
	N	**%**	N	%	N	%	N	%	**N**	**%**	**N**	**%**
Full active, able to carry on all pre-disease performance without restriction.	36	60.0	-	-	-	-						
Restricted in physically strenuous activity but ambulatory and able to carry out work of a light or sedentary nature(light house work, office work)	-	-	10	16.7								
Ambulatory and capable of all self-care but unable to carry out any work activities ,up and about more than 50% of waking hours					3	5.0						
Capable of only limited self –care ,confined to bed or chair more than 50% of waking hours							8	13.3				
Completely disabled ,cannot carry on any self-care: totally confined to bed or chair									3	5.0		
Dead											0	0

(ECOG): Developed by the Eastern Cooperative Oncology Group

Table (4): Comparison between pre and post application of the designed nursing teaching protocol regarding studied sample`s knowledge about neutropenia (n=60)

Variable	Pretest		Posttest		P.v
	N.	**%**	**N.**	**%**	
Function of white blood cells:					
- Transport oxygen and nutrient	1	1.7	-		
- Fight infection	1	1.7	54	100	**0.00****

Variable	Pretest		Posttest		P.v
	N.	%	N.	%	
- Unknown	58	96.7	-		
Symptom of infection:					
- Hair loss	3	5.0	-		
- Redness ,swelling and pain on the wound site	33	55.0	54	100	**0.00****
- Nausea	2	3.3	-		
- Unknown	22	36.7	-		
Symptom of sepsis:					
- Vomiting	8	13.3	-		
- Headache	27	45.0	-		
- Chills and rigors	4	6.7	54	100	**0.00****
- Running nose	1	1.7	-		
- Unknown	20	33.3	-		
Item is suitable to place inside the bed room for patients receiving chemotherapy:					
- Plants	13	21.7	4	7.4	
- fish tank	1	1.7	-	-	**0.00****
- water plants	3	5.0	-	-	
- glass ornaments	-	-	50	92.6	
- unknown	43	71.7	-	-	
Food should be avoided to prevent infection for patients receiving chemotherapy:					
- Salad	34	56.7	54	100	**0.00****
- Unknown	26	43.3	-	-	
Measures must be carried out every day in order to prevent infection:					
- Exercise	10	16.7	49	90.7	
- Shower	27	45.0	5	9.3	
- Take vitamin	4	6.7	-	-	**0.00****
- Unknown	19	31.7	-	-	
Measures must be taken for patient receiving chemotherapy to stay in public area:					
- Hand washing	10	16.	-	-	**0.00****
- Wear surgical mask	19	31.7	54	100	
- Unknown	31	51.7	-	-	
Methods to prevent infection:					
- Take supplement	6	10.0	-	-	
- Take deep breath	1	1.7	-	-	
- Maintain personal hygiene	18	30.0	54	100	**0.00****
- Unknown	35	58.3	-	-	
Measures can prevent oral mucositis:					
- take fluid diet	1	1.7	-	-	
- use homemade	20	33.3	54	100	**0.00****
- Unknown	39	65.0	-	-	
Particular attention to prevent infection:					
- Hand hygiene	22	36.7	54	100	**0.00****
- Unknown	38	63.3	-	-	
If the oral temperature higher than what degree Celsius should seek medical help:					
- 36c	5	8.3	1	1.9	**0.00****
- 38.3c	45	75.0	52	96.3	
- 33.00	0	0	1	1.9	
- Unknown	10	16.7	-	-	
Measures should be taken if patient has fever:					
- Seek medical help from clinical oncology	47	78.3	54	100	**0.00****
- Unknown	13	21.7	-	-	

Use Pearson chi-square (cross tabs test)
**=Significant difference **= highly significance Ns= Non significant difference P value<0.05*
{Six patients not completed the research because they died}

Table (5): Relation between demographic data and studied patient`s knowledge about neutropenia pre and post application designing nursing teaching protocol.

Variable	Pretest				Posttest				P.v1	P.v2
	Satisfactory		Unsatisfactory		Satisfactory		Unsatisfactory			
	N.	%	N.	%	N.	%	N.	%		
age by years										
- 18-28y	2	3.3	10	16.7	10	18.5	0	0		
- 29-39y	1	1.7	14	23.3	11	20.3	2	3.7		0.28
- 40-50y	2	3.3	11	18.3	11	20.3	1	1.85	0.23	
- > than 50	0	0	20	33.3	19	35.9	0	0		
sex										
- Male	3	5.0	18	30.0	17	31.5	2	3.7	0.28	0.22
- Female	2	3.3	37	61.7	34	62.9	1	1.85		
marital status										
- single	2	3.3	14	23.3	15	27.8	0	0	0.67	0.86
- married	3	5.0	31	51.7	28	51.8	3	5.6		
- separated	0	0	4	6.7	3	5.6	0	0		
- widowed	0	0	6	10.0	5	9.25	0	0		
Type of employment										
- housewife	1	1.7	26	43.3	23	42.6	1	1.85	0.002	0.63
- unemploye	2	3.3	13	21.7	15	27.8	0	0		
- profession	1	1.7	5	8.3	2	3.7	2	3.7		
- clerk	1	1.7	6	10.0	6	11.1	0	0		
- other	0	0.0	5	8.3	5	9.25	0	0		
Education level										
- non schooling	0	0	15	25.0	14	25.9	0	0		
- primary school	1	1.7	4	6.7	5	9.25	0	0	0.26	0.48
- secondary school	3	5.0	25	41.7	21	38.9	3	5.6		
- bachelor's degree	1	1.7	11	18.3	11	20.4	0	0		

Use Pearson chi-square (cross tabs test).=Significant difference **= highly significance Ns= Non significant difference P value<0.05*

Table (6): Comparison between total knowledge scores pre and post application of the designed nursing teaching protocol.

Variable	Pretest		Posttest		P.v
	N.	%	N.	%	
- **Satisfactory knowledge (More than 50%)**	5	8.3	51	94.4	**0.00****
- **Unsatisfactory knowledge (Less than 50%)**	55	91.7	3	5.6	

Table (7): Frequency distribution between pre, and post application of the designed nursing teaching protocol regarding complications of neutropenia of studied patients (n=60).

Complications	Pretest Grade 3		Posttest Grade 1		p.v
	N.	%	N.	%	
- **Cardiac disorder**	1	1.7	-	-	0.5
- **Ear disorder**	5	8.3	5	9.25	0.04 *
- **Endocrine disorder**	1	1.7	1	1.85	0. 5
- **Eye disorder**	2	3.3	1	1.85	0.33
- **Gastrointestinal disorder**	21	35.0	19	35.18	0.00**
- **General disorder**	1	1.7	1	1.85	0.5
- **Hebato biliary disorder**	4	6.7	3	5.6	0.02*
- **Immune disorder**	1	1.7	1	1.85	0.5
- **Urinary tract infection**	15	25.0	13	24.1	0.00**
- **Musculoskeletal**	2	3.3	2	3.7	0.16
- **Renal disorder**	5	8.3	5	9.25	0.00**
- **Reproductive system**	2	3.3	2	3.7	0.16
- **Respiratory disorder**	41	68.3	41	75.9	0.00*
- **skin disorder**	4	6.7	4	7.4	0.01
- **Vascular disorder**	1	1.7	1	1.85	0.5

Table (1): Showed that more than half of the studied group were females, married and their ages were 50 years and more (65.0%, 56.7% and 33.3%) respectively. The most common level of education of the studied group was secondary school (46.7%). As regard to type of employment, type of residence and smoking "the majority of the studied group were unemployed, living in rural areas and non-smokers (70.0%, 81.7% and 88.3%) respectively.

Table (2): Clarified that the most common type of cancer among the studied group was" Acute Myeloid Leukemia", the most common stage of cancer was stage 4, the most common chronic illness was cardiovascular disease and more than half of the studied group used antibiotics and G-CSF as a treatment at the onset of admission (35%, 21.7%, 20.0%, 56.7% and58.3%) respectively.

Table (3): Represents that more than half of the studied patients located in" Grade 0" of ECOG performance status which presented (Full active, able to carry on all pre-disease performance without restriction).

Table (4): Showed that there were highly statistically significant differences between "pre and post" application of the designed nursing teaching protocol in all knowledge items P<0.001.

Table (5): Shows that pre- application of the designed nursing teaching protocol the majority of the studied patients who were having unsatisfying level of knowledge were female, house wife and older ages. There was a relation between knowledge and type of employment among studied sample.

Table (6): Showed that a highly statistically significant differences between" pre and post" application of the designed nursing teaching protocol regarding total knowledge scores P.V < 0.00.

Table (7): Showed that there were statistically significant differences between the studied patients before and after application of the designed nursing teaching protocol regarding complications of neutropenia, which included (ear disorder, gastrointestinal disorder, urinary tract disorder, renal and respiratory disorder P<0.0.

Discussion

I-Socio demographic and medical data

Socio demographic data:

The present study explored the following: more than half of the studied patients were females, married and their ages 50 years and more, they were unemployed and non-smokers and this agreed with **Schelenz et al., (2012),** R**asmy et al., (2016) & Gerges, (2018)** who explained the variability of the occurrence of febrile neutropenia related to several factors that contained cancer type, chemotherapy regimen, antibiotic treatment, age and sex. So related to the age and sex, the mean age was 63 years and more than half of patients were females. Also, **Lyman et al., (2003)**, **Desoky et al., (2014) & Hussein & Shehata (2016)** reported that ten results of previous studies found advanced age to be most common risk factor for occurrence of severe neutropenia and other neutropenic complications. Advanced age is a particularly important independent risk factor, since older patients are often treated with lower

chemotherapy doses to minimize the occurrence of neutropenic complications.

In the present study the majority of the studied patients were non -smokers and this was in the same line with **O'Malley et al., (2013), Mahmoud & Zaki (2015) & Ibrahim et al., (2016)** who reported that never smokers had increased neutropenia versus current smokers with different tumor types including breast, lung, pancreatobiliary, or other unknown primary cancer.

Eleonora et al., (2014) & Mohamed., (2015) concluded from their work in medical oncology department that myelo-suppressive chemotherapy is commonly associated with neutropenia; the most affected patients with neutropenia were non smokers, females and elderly patient.

Medical data

This study showed that the most common type of cancer in the studied patients was Acute Myeloid Leukemia and this come in the line with **Lyman et al., (2003) & Khalil et al., (2013)** who reported that patients with hematologic malignancies are at higher risk for neutropenia than patients with solid tumors because of the action disease process as well as the severity of the chemotherapy that is required.

This study revealed that the common stage of cancer in the studied group was (stage 4) and this agreed with **Lyman et al., (2005), Lyman, (2014) & El Sayed et al., (2014)** who reported that both advanced disease and uncontrolled cancer were significant predictors of hospitalization for febrile neutropenia and serious neutropenic complications, including death. Also**,** this result agreed with **Salar et al., (2012) & Ahmed et al., (2015)** who reported that six studies have found advanced disease (higher disease stage or bone marrow involvement) to be a significant predictor of febrile neutropenia. These studies performed in various cancers, including Non Hodgkin Lymphoma, breast, ovarian, lung, colorectal, and prostate cancer.

Current study concluded that, the majority of the studied patients were from rural area, this may be one cause of the advanced cancer stage in large numbers among the studied patient.

The result of the current study noticed the presence of chronic illness with patients complained from neutropenia and most of these illnesses were cardiovascular disease and this was in line with **Kuderer et al., (2004), Yakoot et al., (2010)**, **& Said et al., (2017)** who revealed that the presence of comorbid conditions with cancer has been shown to increase the risk for neutropenia and its infectious complications. Renal disease and heart disease have been shown to increase the risk for febrile neutropenia. Such as hypertension, chronic obstructive pulmonary disease, pneumonia, prior fungal infection, and sepsis have been shown to increase the risk for serious neutropenic complications, including prolonged hospitalizations for febrile neutropenia and death.

As regard medication use with neutropenia the present study revealed that more than half of the studied group used antibiotics and Granulocyte colony-stimulating factors (**G-CSF)** as a treatment at the onset of admission and this agreed with **National Chemotherapy Advisory Group (NCAG, 2015) & Hashiguchi et al., (2015)** recommendation that ensures the use of broad-spectrum antibiotics as first-line antibiotics in all cases. Also **Crawford et al., (2011) & Ahmed, (2017)** stated that in many cases, **G-CSFs** are administered to patients with malignancy to prevent such events.

ECOG Performance Status: Was developed by (the Eastern Cooperative Oncology Group)**Oken et al., (1982)** this study revealed that more than half of the studied patients located in grade "0" full active, able to carry on all pre disease performance without restriction, this finding disagreed with **Voog et al., (2000), Lakhanpal (2015) & Wai & Shirley, (2015)** who reported that three studies have shown that, in addition to age, poor performance status is a significant risk factor for chemotherapy- induced neutropenia. The finding of this study was similar to **Nirenberg et al., (2006), & the National Comprehensive Cancer Network (NCCN) guideline update (2011)** when they indicated that poor performance status was not clearly identified as a risk factor for febrile neutropenia.

Patient`s knowledge about neutropenia

The current study revealed a lack of patients' knowledge related to chemotherapy induced neutropenia (CIN) at baseline where mostly had unsatisfactory knowledge levels. However, post applying the designed nursing teaching protocol the studied patients achieved significant improvements in knowledge. This result agreed with **Hussein and Shehata (2016).** Also researchers from the Waukesha Memorial Hospital in Wisconsin **Finkler et al., (2003)** issued a survey to 79 oncology patients to assess their knowledge and understanding of chemotherapy induced neutropenia (CIN) and their results indicated that more than half of patients did not know when to contact their physician or oncology nurse and approximately one-third of their patients didn't know infection signs and symptoms. Also around half of them could not describe self-care measures where this result also agreed with **Abd El-all et al., (2014).**

The researcher noticed that it is necessary for the patients undergoing chemotherapy to detect early as possible of chemotherapy induced neutropenia (CIN) in order to avoid the development of life-threatening

infections, a patient's role, however, is largely dependent upon the information they receive from oncology nurses or physicians**.(Mahmoud & Zaki, 2015) & (Teleb & Mohamed, 2016)**

Best et al., (2011) & Whitlock, (2018) added that the importance of prompt check of abnormal body temperature should be emphasized specially for patients receiving myelo-suppressive chemotherapy and initiating antibiotic therapy in a timely manner is effective in treat febrile neutropenia because the any delay in treatment may lead to highly risk for sepsis and death. Also **Meyerhardt et al., (2004)** & **Wai & Shirley, (2015)** mentioned that a lack of knowledge was one of the patient-related variables which can be eliminated through the education program.

Complications of neutropenia patients

The results of recent study represented that about two thirds of the sample had respiratory infection and about one third of the studied patients had gastrointestinal disorder pre application of designed nursing teaching protocol. This was in line with **Nirenberg, (2006) & Ngo-Matip et al., (2015)** who stated that the digestive system including oral cavity, esophagus, colon and rectum are the major body parts of infection during neutropenia. Chemotherapy side effects are eutropenic enterocolitis or typhlitis is a severe form of mucosal barrier injury, the respiratory tract, mainly sinuses and lungs, is a common site of infection during neutropenia.

During a short period of neutropenia less than 7 days, pneumonia and sinusitis are usually caused by common respiratory pathogens. The skin including the catheter-site can be a major source of severe infections during neutropenia. Also, this agreed with **Ramphal, (2004) & Hanan et al., (2014)** who stated that infections occur in 20%–30% of febrile episodes. The intestinal tract, lung, and skin are the common sites of tissue-based infection. Bacteremia occurs in 10%–25% of all patients, with most episodes occurring in the setting of prolonged or profound neutropenia.

Conclusion

In light of the existent study finding, it is concluded that there were a highly statistically significant differences between before and after the designed nursing teaching protocol application in all items of knowledge assessment sheet. Likewise there were a highly statistically significant differences between the studied patients' complications of neutropenia before and after application of the designed nursing teaching protocol regarding.

Recommendation

The study recommended that

1. Oncology patients undergoing chemotherapy and complaining from neutropenia are critical patients, so they need for qualified nursing staff for caring with them.
2. Each patient undergoing chemotherapy should have the designed nursing teaching protocol Arabic booklet about neutropenia.
3. Powerful substantial tools also patients, families, and healthcare workers' health training programs are important for incite change and correspondence about conceivably dangerous indications related with neutropenia.

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