

Efficacy of Protocol for Pain Control on Clinical Outcomes of Patients with Solid Tumor

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Abstract :Background: Postoperative pain is among the main concerns of the patients under solid tumor surgery and it is one of the most challenging clinical problems for the health care providers in acute care setting. **Aim:** This study aimed to evaluate the efficacy of protocol for pain control on clinical outcomes of patients with solid tumor.**Subject and Method:** A quasi- experimental research study was conducted in the Intensive Care Unit; Surgery Department at Tanta Cancer Center affiliated to the Ministry of Health, Tanta, Egypt. The sample consisted of 40 adult patients and fulfilling the inclusive criteria, Oral and written consent was obtained from patients and/or their families after the explanation of the study purpose. They divided into two equal groups: Group I: Study group received protocol for pain control (Foot reflexology) by the researcher and under prescribed hospital pain management. Group II: Control group received only routine hospital pain management. **Three tools** were used for data collection as follows: **Tool (I) Patient's bio-sociodemographic data;** it consisted of two parts: Part A was patient's bio-sociodemographic data, Part B was solid tumor patient physiological parameters assessment. **Tool (II) Pain assessment tool (McGill pain questionnaire);** it comprised two parts: Part A was pain rating index; Part B was present pain intensity. **Tool (III) Sleep quality tool (Groningen sleep quality scale).** **Results:** The main results revealed that physiological parameters as vital signs and mean arterial blood pressure were improved in the study group and Intensity of pain decreased in the study group. Also, sleep quality improved in the study group. **Conclusion and recommendations:** Practicing foot reflexology could be useful in postoperative pain management after solid tumor surgery. The study recommended that all patients with solid tumor surgery should be assessed for pain immediately after surgery and different non-pharmacological pain measure should be applied immediately postoperatively.

Keywords: foot reflexology, pain control, patient outcomes, solid tumor:

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I. Introduction

Cancer is the most fearful of all diseases known to man, regardless of one's intellectual, educational background, or social standard. No other diagnosis is capable of producing the terror-stricken response that cancer evokes⁽¹⁾. Surgery has been used to treat cancer for many years. Surgery offers the greatest chance for the cure of many types of cancer, especially solid tumors that have not spread to other parts of the body⁽²⁾.

Solid tumor is defined as the abnormal mass of tissue that usually does not contain cysts or liquid areas and may be benign or malignant⁽³⁾. Major abdominal surgery is a treatment modality for patients as in cancer stomach or colon. Thus, management of postoperative symptoms becomes an essential part of nursing care. Despite this, postoperative pain management remains one of the major challenges in care of surgical patients. The understanding of acute pain physiology has advanced, and new methods of pain management have emerged. Although care has improved, studies still show that postoperative pain continues to be inadequately treated, and those patients still experience moderate to severe pain after surgery^(4, 5).

Although western medicine is still a mainstream for patients with postoperative pain, complementary and alternative therapies that could help in promoting comfort have recently begun to gain acceptance by practitioners⁽⁶⁾. Since 1997, the United States National Institutes of Health issued a report acknowledging that alternative and complementary therapies could alleviate some side effects of treatment, such as pain and improve sleep⁽⁷⁾. The use of complementary and alternative therapies (CAT) has increased in conventional healthcare settings^(8, 9). The fear from medication side effects and desire for symptoms relief are possible

reasons for the increased use of CAT by patients. However, many CAT modalities lack scientific evidence to support their efficacy and safety⁽¹⁰⁾.

In many countries, reflexology is increasingly playing an important part as an adjunct to traditional medicine as a method of pain relief. Foot reflexology has a long historical pedigree to be identified in both ancient Chinese and Egyptian tradition its use even being noted in hieroglyphics and the use of reflexology has been practiced since the age of pharaohs. In fact, it is proposed that it can help cancer patients after surgery as they seek to manage their symptoms and perform tasks associated with daily living^(11, 12).

Reflexology is a manual technique based on the zone theory that reflex points on the feet correspond to organs, glands, and parts of the body. These points are linked to internal organs and structures by energy channels, zones, and/ or meridians. When illnesses or imbalances occur in the body, consequent energy channels become blocked. Reflexology massage is used to open up these blockages, thus allowing energy to flow freely again, restoring the body's natural balance and health⁽¹³⁾. Based on the neuromatrix theory of pain, reflexotherapy is also thought to relieve pain by transmitting afferent impulses and close the neural gates in the dorsal horn of the spinal cord, thus blocking pain transmission⁽¹⁴⁾. The technique of reflexology is simple, can be performed anywhere, requires no special equipment, is noninvasive, and does not interfere with other treatments a patient may receive⁽¹⁵⁾. The use of foot reflexology massage by nurses is easy and practical as noted by one nurse researcher who writes: "foot reflexology massage is a way to enhance the nurse-patient interrelationship. It offers a strategy to fulfill the goals for human touch and holistic nursing care. It can be performed at any location, is non-invasive, and does not interfere with patients` privacy."^(16, 17).

Fernandez et. al,⁽¹⁸⁾ evaluated the efficacy of reflexology and on the physiological measures of relaxation. They concluded that 13.9% of Intensive Care Unit mortality rate was due to the physiological parameters alteration. Another study⁽¹⁹⁾ showed the effect of five- minute- foot massage on the physiological parameters of the critically ill patients. Results indicated that foot massage had the potential effect of increasing relaxation, as there were physiological changes after the intervention of foot massage.

When patients have pain, significant problems may occur with daily functioning; mobility, sleep, diet, exercise, social/family/relationship problems⁽¹⁴⁾. Pain leads to anxiety and inability to sleep. Sleep is also disrupted by environmental factors, including noise and bright lights that disrupt the natural light-dark rhythm. Sleeplessness may make the perception of pain seem much worse⁽²⁰⁾.

Non-pharmacological measures for pain control include the application of complementary therapies that are used by cancer patients to treat pain, anxiety, distress, sleep disturbance, fatigue, stress, anorexia, nausea, diarrhea, constipation, lymph edema, pruritus, neuropathy, joint or muscle dysfunction, vasomotor symptoms due to hormonal treatment, and more. Conventional treatments may not relieve these symptoms, and patients cannot often tolerate their side effects. In such situations, complementary therapies are useful such as therapeutic touch, acupuncture, mind-body therapy, heat or cold application, guided imagery, relaxation techniques, and foot reflexology^(21, 22).

Although sleep difficulty is associated with various medical conditions, including cardiovascular, respiratory, and painful musculoskeletal conditions, little is known about sleep quality in people with cancer⁽²⁰⁾. **Sleep quality:** It is defined as one's satisfaction of the sleep experience, integrating aspects of sleep initiation, sleep maintenance, sleep quantity, and refreshment upon awakening⁽²³⁾. It seems likely that the emotional and physical distress of cancer would be associated with sleep problems^(24, 25). Foot reflexology had an effect on physiological parameters of the critically ill patients which include a significant difference in pulse rate, respiratory rate, systolic blood pressure, diastolic blood pressure, mean arterial blood pressure (MABP) and peripheral O₂ saturation^(26,27).

Protocol of care for cancer pain control: It is a protocol of pain management using reflexology (pressure applied on feet to harmonize bodily functions and thus has a healing and pain relief effect) with the patient under prescribed hospital routine care⁽²⁸⁾. The critical care nurse plays an important role in assessing pain for postoperative cancer patients and evaluation of efficacy of reflexology technique intervention, which can improve recovery and prognosis⁽²⁹⁾. Additionally with consumer interest in CAT, nurses have increasingly incorporated these modalities into their practice. For example, reflexology has been widely used in fields such as orthopedics, neuroscience and palliative care⁽³⁰⁾. Therefore, nurses must have a sound understanding of the scientific principles underlying the importance of the need of protocol for pain control, so this study was done to evaluate efficacy of protocol for pain control on clinical outcomes of patients with solid tumor^(30, 31).

II. Subjects and Methods

Aim of the study

The aim of this study was to evaluate the efficacy of protocol for pain control on clinical outcomes of patients with solid tumor.

Research hypothesis:

The study group who has been exposed to protocol of pain control and routine hospital pain management (by the researcher) exhibited a low level of pain and improved their quality of sleep more than the control group who has been managed by only prescribed hospital routine pain management.

III. Subjects

Research design:

The study was used a quasi- experimental research study.

Setting:

The study was conducted at the intensive care unit, surgery department at Tanta Cancer Center affiliated to the Ministry of Health.

Subjects:-

A convenient sample of 40 adult patients of both sexes with solid tumor postoperatively based on Statistical Power Analysis were selected and divided into two equal groups, twenty patients in each group as followings:

Group 1: Study group, received protocol for pain control by the researcher and under prescribed hospital pain management.

Group 2: Control group, received routine hospital pain management only.

The subjects were selected according to the following criteria:

Inclusion criteria:

- Patients with solid tumors post operatively (such as cancer colon and cancer stomach),able to communicate verbally and non-verbally& Adult patients (21 year and above).

Exclusion criteria:

- Patients have received medical treatment for chronic pain (more than 6 months),had arterial lines or suppurating/infective skin conditions of the foot and spread infection to the therapist. Patients with hematological cancer because this can increase risk of bruising and bleeding. Finally Patients with neuromuscular impairment such as epilepsy, brain injury and multiple sclerosis.

Tools of data collection:Three tools were utilized to collect data for the study.

Tool 1. Patient Assessment Tool: It was developed by the researcher in order to collect the baseline data. It consists of two parts:

a- Part one: Patient's bio-sociodemographic data such as age, sex, marital status, educational level, occupation, date of admission, duration of hospital stay, previous and current medical history, previous hospitalization, body weight, history of sleep, pain medications received and activities of daily living .

b- Part two: Physiological parameters data: It was developed by the researcher to monitor changes in heart rate, peripheral O₂ saturation, respiratory rate and mean of blood pressure (MBP).

Tool II. Pain Assessment Tool “Modified short form of McGill pain questionnaire-MPQ-SF”, this tool “Modified short form of McGill pain questionnaire-MPQ-SF” was adopted from **Melzack in 1987** ^(32,33), and it was used by the researcher for a clinical assessment of pain in the study and it has been found to be a valid, reliable and useful research tool for pain measurement in both clinical and research settings. It consisted of two parts:

a- Part one: Pain Rating Index includes eleven sensory and four affective pain descriptors. The eleven sensory descriptors include throbbing, shooting, stabbing, sharp, cramping, gnawing, hot/burning, aching, heavy, tender, and splitting pain. The four affective pain descriptors include tiring, sickening, fearful and punishing.

Scoring system: The patient was asked to select from a list of 15 descriptors that describe their pain and they rate the intensity of each selected descriptor as mild = 1, moderate = 2 and severe = 3. The sensory and affective scores are derived from summation of scores of each item. The total score was the summation of scores from sensory and affective domains. The maximum value is 45 score and the minimum value is 15 score.

b- Part two: Present Pain Intensity (PPI) scale: It was used to assess the intensity of pain. It ranges from 0-5 where 0 indicated "no pain" and 5 indicated "excruciating pain". The scores corresponding to the PPI as shown: (0) no pain, (1) mild, (2) discomforting, (3) distressing, (4) horrible and (5) excruciating.

Tool III. Sleep Quality Tool “The Groningen Sleep Quality Scale”

Groningen Sleep Quality Scale was developed by **Hajonides, et. al in 1980** ⁽³³⁾ and modified and translated into Arabic version by **Shaban Y in 2008** ⁽³⁴⁾ and it was adopted and used by the researcher to assess patient subjective quality of sleep at the night before.

Scoring system: The scale consisted of 15 statements, which scored as true, or false, maximum 14 points indicating poor sleep at the night before, in which the first question does not count for the total score. Each patient was asked to answer to each statement of scale by either true or false. One point was given if the answer is true in questions number 2, 3, 4, 5, 6, 7, 9, 11, 13, 14 and 15. One point was given if the answer is false in questions 8, 10 and 12. Total score for quality of sleep was calculated by scores of; good: 0-5, fair: 6-8 and poor: 9-14.

IV. Method

The study was accomplished through the following steps:

1. Administrative process:

- a- An official letters from the faculty of nursing were delivered to the appropriate authorities in the selected area to conduct the study.
- b- Permission to conduct the study was obtained from the directors of the selected settings.

2. Ethical consideration:

- Oral and written consent was obtained from patients and/or their families after the explanation of the study purpose.
- Privacy and confidentiality were assured to participants. Anonymity and patient right to be withdrawn from the study at any stage were respected and assured.

3. Tools development:

Tool I: part A (**Patient's bio-sociodemographic data**) and B(**Physiological parameters data**) was developed by the researcher after extensive review of the relevant literatures.

Tool II. (Pain Assessment Tool "Modified short form of McGill pain questionnaire-MPQ-SF") Part one (Pain Rating Index) and Part two (Present Pain Intensity (PPI) scale) was adopted from Melzack in 1987.

Tool III: (Groningen Sleep Quality Scale) was developed by Hajonides, et. al in 1980 and modified and translated into Arabic version by Shaban Y in 2008.

4. Tools validity: All tools were tested for content validity by nine jury of experts in the field. They were tested for comprehensive appropriateness and modification was done.

5. Reliability: The reliability of McGill pain questionnaire has been acceptable and it was tested by using Cronbach's alpha test and it was greater than 0.85^(32, 33). Also, the reliability of Groningen Sleep Quality Scale has been acceptable and it was tested by using Cronbach's alpha test and it was greater than 0.88.

6. A pilot study: It was conducted before the actual study, on five patients in order to test the clarity, feasibility and the applicability of the different items of the determinant tools and they were excluded from the total number of the study subjects.

- Data collection was conducted within the period from the first of November 2014 to the end of March 2015.
- The researcher received a training course on foot reflexology in Open Academy of Complementary Medicine-Cairo Center. World Federation of Alternative and Complementary Medicine supported this center. The training course included 90 credit hours from the first July 2014 to the fourth of July 2014.

7. The study was carried out on four phases:

1. Assessment phase: patient baseline data was done by using tool I part one for both the control and study groups before protocol for pain control. The interview questionnaire was asked to all patients to assess bio-sociodemographic data preoperatively. Each interview took approximately 20 minutes.

- Assessment was done for both groups in immediate postoperative two hours as the follows:

a. Assessment of the patient's physiological parameters such as heart rate, peripheral O₂ saturation, respiratory rate and mean of blood pressure (MBP) was done by using tool I, part two were used for the study and control groups before and after each session from the first to the third day and were used for follow up in the fifth and the seventh days after the application of protocol of care and routine hospital pain management.

b. Assessment of patient's quality and intensity of pain using tool II, part one and two. Tool I part two and tool II part one and two were used for the study and control groups before and after each session from the first to the third day and they were used for follow up in the fifth and the seventh days after the application of protocol of care and routine hospital pain management.

c. Assessment of patient's sleep quality using tool III. Tool III was used for the study and control groups after each session of reflexology from the first to the third day and it was used for follow up in the fifth and the seventh days after the application of protocol of care and routine hospital pain management.

11. Planning phase: Proposed foot reflexology program for study group post operatively determining its objectives was designed based on determined needs, baseline measures, relevant literatures and researches. In

order to be implemented using various methods including a booklet contains diagrams and pictures which was designed by researcher in Arabic language.

III. The implementation phase:

- **Group 1 (control group)** Control group received the routine nursing care provided for the patients by nurses and routine hospital pain management.

- **Group 11 (study group)** Study group received protocol of pain control by the researcher and under their prescribed hospital pain routine managements. The protocol of pain control was applied to all patients included in the study group including three reflexology sessions over three consecutive days in one week each session took about 35-40 minutes as follows:-

1. Preparation step of reflexology technique: - It took about 10 minutes, it included the following: the researcher administered Analgesic prescribed by physician before starting the implementation of foot reflexology. The purpose and steps of procedure were explained to patient by the researcher. Being at patients' bedside in the afternoon shift. Hand washing and prepare equipment (towels, warm water in a tub, favorite essential oil (preferably lavender), and pillow). Bedside curtains were drawn. Feet were soaked in warm water, and they were completely dried before starting foot reflexology massage session. Comfortable position was assured during session (patient lying in supine position with pillow under his head and the researcher sits opposite in a low chair). Proper pillow and towel were applied. Lavender oil was applied in a sweeping motion (35,36).

2. Implementation step: - It took about twenty minutes for performance of reflexology technique ten minutes for each foot. It includes three-foot reflexology sessions over three consecutive days in one week starting from first day of surgery and encompass direction of massage and other basic massage strokes on feet.

3. Documentation step: - It took a 10 minutes for obtaining and recording of physiological parameters such as (heart rate, peripheral O₂ saturation, respiratory rate and mean of blood pressure (MBP)) by using by using tool 1, part two and patient's quality and intensity of pain by using tool II, part one and two before and after each session of foot reflexology.

4. The evaluation phase: Evaluation was done for patients of both groups by using Tool 1 part two and tool II part one and two before and after each session from the first to the third day and used for follow up in the fifth and seventh day after the application of protocol of care and routine hospital pain management. Tool III was used for both groups after each session of foot reflexology from the first to the third day and it was used for follow up in the fifth and the seventh days after the application of protocol of care and routine hospital pain management.

8- Comparison was done between both groups to evaluate the efficacy of protocol for pain control on clinical outcomes of patients with solid tumor.

Limitations of the study:

Reflexology had a low effect in the first session because of the severity of pain and lack of cooperation from the patients. Some patients found a difficulty in some pain descriptors in Tool II, part one to understand and this needed more help from the researcher to clarify them, so the researcher translated the pain descriptors into Arabic language to facilitate the patient's understanding.

Statistical analysis:

The collected data were organized, tabulated and statistically analyzed using SPSS software (Statistical Package for the Social Sciences, version 16, SPSS Inc. Chicago, IL, USA). For quantitative data, the range, mean and standard deviation were calculated. For qualitative data, comparison between two groups and more was done using Chi-square test (χ^2) and Fisher Exact test (FE). For comparison between means of two groups of parametric data of independent samples, student t-test was used. For comparison between means of two groups of non-parametric data of independent samples, Z value of Mann-Whitney test was used. (37).

V. Results

The biosocial-demographic characteristics of studied subject revealed that approximately two-thirds 65% and 60% of the study and control groups were males respectively. More than half 55% and near one-third 30% in both groups were in the age group 50-<60 years respectively. Minority 10% of the study group was read and write compared to 15% of the control group. Also, the majority 95% and 100% of patients in the study and control groups were married. In relation to the current and past medical and surgical history of postoperative study group, it was found that 35% of them had gastric ulcer compared to a quarter 25% of the control group. In addition, majority 80% and 75% of the study and control groups were previously hospitalized. Regarding the previous surgical history, it was found that near half 40% and 45% of the study and control groups had no previous surgery.

Table (1):- Preoperative pattern of daily living activities, pain associated, analgesic effect & associated symptoms of postoperative study & control group patients with solid tumor (n=40).

Pattern of daily living activities	The studied patients with solid tumor (n=40)				χ^2	P
	Study group (n=20)		Control group (n=20)			
	n	%	N	%		
Performance of ADL affected:						
Yes	20	100	20	100	0.000	1.000
No	0	0	0	0		
Feeling of pain during ADL						
Yes	20	100	20	100	0.000	1.000
No	0	0	0	0		
#Description of pain that felt during performance of daily activities:						
Burning	8	40.0	9	45.0	0.000	1.000
Throbbing	5	25.0	4	20.0	0.000	1.000
Colic	9	45.0	9	45.0	0.000	1.000
Pressure	3	15.0	5	25.0	FE	0.694
Aching	2	10.0	4	20.0	FE	0.661
Effect of pain on daily living activities:						
Cannot go out of bed	0	0	3	15.0	9.077	0.028*
Can go out of bed & walk to the bathroom only	2	10.0	6	30.0		
Can do out of bed & walk in the room	6	30.0	7	35.0		
Exercise daily activities with assistance of others	12	60.0	4	20.0		
Effect of pain on personal hygiene:						
Work for self every day personal care	12	60.0	3	15.0	10.036	0.007*
Do daily personal care with the help of others	8	40.0	14	70.0		
Cannot do personal care and others care him/her	0	0	3	15.0		
Effect of analgesics to alleviate pain:						
Partially alleviate severity of pain	4	20.0	2	10.0	0.784	0.376
Totally alleviate severity of pain	16	80.0	18	90.0		
#Gastrointestinal symptoms associated with pain that occur during performance of activities of daily living:						
Burning sensation in stomach	7	35.0	10	50.0	0.410	0.522
Indigestion	9	45.0	8	40.0	0.000	1.000
Nausea	4	20.0	6	30.0	0.130	0.715
Vomiting	10	50.0	9	45.0	0.000	1.000
Diarrhea	5	25.0	6	30.0	0.000	1.000
Constipation	6	30.0	3	15.0	FE	0.450
Respiratory symptoms associated with pain that occur during performance of activities of daily living:						
Shortness of breath	4	20.0	5	25.0	0.000	1.000
No problems	11	55.0	12	60.0	0.000	1.000
Chest pain	5	25.0	3	15.0	FE	0.694

Study group=Patients received protocol of pain control by the researcher & under prescribed hospital pain management.

Control group=Patients received routine hospital pain management only.

#More than one answer was chosen FE=Fisher Exact test

Table (1):-illustrates the pattern of daily living activities, pain associated analgesic effect & associated symptoms of the study and control group patients with solid tumor postoperatively. It was found that all patients 100 % of both the study and control groups were affected and had pain. **In relation to the effect of pain on daily living activities.** Also, a significant difference was found between the two groups with regard to inability to get out of bed, where P= 0.028 while near two thirds 60% of the study group compared to 20% of the control group performed exercises of daily living activities with the assistance of others. Also, 60 % of the study group performs daily personal hygiene without the help of others compared to 15% of the control group. Moreover, gastrointestinal symptoms associated with pain that occur during performance of activities of daily living, half of the control group 50% had burning sensation in stomach compared to 35 % of the study group. **Concerning the effect of analgesics used to alleviate pain,** the majority of the study and control groups 80% and 90% respectively had totally decreased their pain after taking analgesics.

Table (2):- Preoperative sleep history of postoperative study and control group patients with solid tumor (n=40).

Sleep history items	The studied patients with solid tumor (n=40)				χ^2	P
	Study group (n=20)		Control group (n=20)			
	N	%	N	%		
No. of sleeping hours/ day: <6 6-8	9 11	45.0 55.0	10 10	50.0 50.0	0.100	0.752
Occurrence of insomnia during sleep: Yes No	9 11	45.0 55.0	10 10	50.0 50.0	0.100	0.752
Occurrence of dyspnea during sleep: Yes No	4 16	20.0 80.0	5 15	25.0 75.0	0.143	0.705
Occurrence of pain while changing position during sleep: Yes No	7 13	35.0 65.0	6 14	30.0 70.0	0.114	0.736
Need more than one pillow during sleep: Yes No	5 15	25.0 75.0	6 14	30.0 70.0	0.125	0.723
Habits followed to help falling asleep: Didn't do anything Drink warm liquids Read / listen to the Quran Taking a warm bath	13 2 5 0	65.0 10.0 25.0 0	11 4 4 1	55.0 20.0 20.0 5.0	1.944	0.584

Table (2) illustrates Preoperative sleep history of postoperative study and control group patients with solid tumor. It was found that half 50 % of patients in the control group had troubles in sleeping as the occurrence of insomnia during sleep compared to 45 % of the patients in the study group. Most of the patients in the study group 80% % had no dyspnea during sleep compared to 75% of patients in the study group. Also, it was found that more than one third 35% of the study group patients used measures to help them falling asleep as; drinking of warm fluids, reading or listening to Quran, and/ or taking warm bath and in 45% of patients in the control group.

Table (3):- Postoperative analgesics types used for solid tumor patients (n=40).

Postoperative analgesics used	The studied patients with postoperative solid tumor (n=40)															
	Study group (n=20)								Control group (n=20)							
	1 st day		2 nd day		3 rd day		5 th day		1 st day		2 nd day		3 rd day		5 th day	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Opioid Analgesic	19	95.0	1	5.0	1	5.0	0	0	19	95.0	0	0	0	0	0	0
Non-opioid Analgesics	0	0	11	55.0	0	0	0	0	0	0	11	55.0	12	60.0	7	35.0
Nonsteroidal anti-inflammatory drugs	1	5.0	8	40.0	0	0	0	0	1	5.0	9	45.0	8	40.0	2	10.0
No analgesics	0	0	0	0	19	95.0	20	100	0	0	0	0	0	0	11	55.0
χ^2 (study vs control groups)	0.000		1.059		40.000		11.613									
P	1.000		0.589		0.0001*		0.003*									

Table (3) shows the postoperative analgesics types used for solid tumor patients. In the 1st postoperative day, opioid analgesics were administered for most of 95%, 95% of patients while non-opioid analgesics were given for more than half 55%, 55% in the study and control group patients respectively. Also, it was found that in the 2nd postoperative day, non-steroidal anti-inflammatory drugs were administered for near half 40% and 45% of patients in both the study and control groups. On the other hand, in 3rd & 5th postoperative days, majority 95% and all 100% of patients in study group were not given analgesics compared to zero% and more than half 55% of patients in the control group respectively. Statistical significant differences

were found in the study group related to the postoperative analgesics medication used in the 3rd and 5th postoperative days where $\chi^2=40.000$ at p value= .0001 and $\chi^2=11.613$ at p value=.003 respectively.

Table (4):- Postoperative physiological parameters before & after foot reflexology of both the study and control group patients with solid tumor at 7 follow up days (n=40).

Physiological parameters at postoperative days of follow up	The studied patients with postoperative solid tumor (n=40)					
	1. Respiratory rate at postoperative days of follow up					
	Study group (n=20)			Control group (n=20)		
	Before implementation of foot reflexology + routine hospital pain management	After implementation of foot reflexology + routine hospital pain management	Paired t-test P	Before routine hospital pain management	After routine hospital pain management	Paired t-test P
Range Mean±SD	Range Mean±SD		Range Mean±SD	Range Mean±SD		
1 st day	17-22 19.10±1.16	15-19 17.15±0.99	14.419 0.0001*	17-21 19.20±1.10	16-20 17.90±0.91	10.177 0.0001*
2 nd day	15-18 16.60±0.82	13-17 14.65±1.09	17.085 0.0001*	15-19 17.10±1.12	14-17 15.75±1.07	6.899 0.0001*
3 rd day	14-16 14.95±0.82	12-15 13.20±0.89	10.925 0.0001*	15-18 16.30±0.98	14-17 15.00±0.86	7.935 0.0001*
5 th day	12-16 13.55±1.05			13-17 15.00±1.21		
7 th day	12-15 13.15±0.87			12-16 14.30±1.17		
F-value P	129.83 0.0001*	80.843 0.0001*		58.512 0.0001*	50.108 0.0001*	
	2. Peripheral O ₂ saturation at postoperative days of follow up					
1 st day	97-100 98.20±1.10	98-100 98.85±0.74	3.901 0.001*	96-99 97.55±0.89	95-99 97.20±1.00	1.677 0.110
2 nd day	96-99 97.45±0.69	98-100 98.60±0.75	6.328 0.0001*	94-98 96.20±1.10	95-98 96.60±0.75	1.710 0.104
3 rd day	96-98 97.15±0.58	97-99 98.35±0.74	7.712 0.0001*	94-98 96.40±1.19	96-99 97.00±1.17	3.040 0.007*
5 th day	98-100 98.35±0.59			95-99 97.30±1.22		3.472 0.001*
7 th day	98-100 98.35±0.59			96-99 97.55±0.89		3.749 0.001*
F-value P	12.357 0.0001*	2.234 0.116		7.448 0.0001*	1.900 0.159	
	3. Heart rate (HR) at postoperative days of follow up					
1 st day	85-95 87.90±2.81	80-87 83.90±2.05	6.325 0.0001*	84-89 86.70±1.42	81-88 85.15±1.56	5.264 0.0001*
2 nd day	77-87 84.40±2.80	75-86 81.05±3.09	10.011 0.0001*	78-87 81.95±2.91	75-86 80.00±3.23	5.800 0.0001*
3 rd day	74-87 80.60±3.59	73-82 77.20±2.73	9.299 0.0001*	75-85 80.15±3.57	73-84 78.80±3.34	2.624 0.017*
5 th day	72-81 76.60±2.70			74-85 79.65±2.83		3.483 0.001*
7 th day	72-79 75.40±1.73			74-84 78.70±2.73		4.560 0.0001*
F-value P	70.735 0.0001*	32.065 0.0001*		25.995 0.0001*	27.737 0.0001*	

*Significant (P<0.05)

Table (4):- Postoperative physiological parameters before & after foot reflexology of both the study and control group patients with solid tumor at 7 follow up days (n=40). (Continued)

Physiological parameters at postoperative days of follow up	The studied patients with postoperative solid tumor (n=40)					
	4. Systolic BP at postoperative days of follow up					
	Study group (n=20)			Control group (n=20)		
	Before implementation of foot reflexology + routine hospital pain management	After implementation of foot reflexology + routine hospital pain management	Paired t-test P	Before routine hospital pain management	After routine hospital pain management	Paired t-test P
Range	Range		Range	Range	P	
Mean±SD	Mean±SD		Mean±SD	Mean±SD		
1 st day	90-149	100-130	1.816	99-134	100-130	0.161
	105.50±13.49	109.30±7.97	0.085	104.25±7.52	104.15±6.64	0.873
2 nd day	100-130	100-125	2.617	99-130	100-125	4.597
	112.55±7.04	109.70±7.70	0.017*	105.95±7.07	103.40±6.03	0.0001*
3 rd day	100-126	100-120	1.857	100-130	100-120	2.378
	115.05±6.77	112.00±5.94	0.079	111.55±8.09	109.35±5.38	0.028*
5 th day	100-125			108-125		
	112.80±6.42			115.75±5.34		
7 th day	100-120			105-126		
	115.00±6.07			117.70±6.79		
F-value	4.357	0.806		14.832	5.756	
P	0.003*	0.452		0.0001*	0.005*	
5. Diastolic BP at postoperative days of follow up						
1 st day	60-86	60-80	0.337	60-86	60-85	1.294
	67.75±7.04	68.15±6.49	0.740	66.85±6.17	66.05±6.11	0.211
2 nd day	60-85	60-80	1.014	60-85	60-82	2.364
	70.65±7.66	69.50±6.67	0.323	68.90±5.90	67.45±4.86	0.029*
3 rd day	65-80	65-80	1.763	65-83	60-80	5.367
	73.50±3.66	71.55±3.35	0.094	73.45±5.11	70.70±5.21	0.0001*
5 th day	60-80			70-85		
	72.00±5.00			74.30±5.02		
7 th day	60-80			66-82		
	75.00±6.07			75.65±5.11		
F-value	4.205	1.798		9.424	3.875	
P	0.004*	0.175		0.0001*	0.029*	
6. Mean of BP at postoperative days of follow up						
1 st day	22-63	30-50	1.798	30-48	28-45	0.899
	37.75±9.75	41.15±5.67	0.088	37.40±5.18	38.10±3.94	0.380
2 nd day	35-50	30-55	1.180	24-50	30-45	1.473
	41.90±4.95	40.20±7.10	0.252	37.05±6.39	35.80±4.99	0.157
3 rd day	30-50	30-50	1.802	25-50	30-50	0.666
	42.05±5.01	39.95±4.24	0.087	38.10±6.14	38.65±4.69	0.543
5 th day	30-50			35-50		0.389
	40.80±5.80			41.45±4.71		0.699
7 th day	30-50			35-50	2.194	1.838
	40.00±3.24			42.05±3.79	0.121	0.074
F-value	1.624	0.239		3.812		
P	0.175	0.788		0.006*		

*Significant (P<0.05)

Table (4) shows the effect of foot reflexology on physiological parameters of the studied patients with postoperative solid tumor before & after foot reflexology at 7 follow up days. It was found that a statistical significant difference between patients in both groups in relation to the respiratory rate at the 1st, 2nd, 3rd days while the difference wasn't statistically significant at the 5th & 7th postoperative days. **Regarding the peripheral O₂ saturation at the 1st, 3rd, 5th and 7th post-operative day**, the mean±SD was 98.20±1.10 before and 98.85±0.74 after the implementation of foot reflexology and routine hospital pain management in the study group, compared to 97.55±0.89 of the patients in the control group. Also, at postoperative follow up days, it was found that the difference between both the study and control groups according to the peripheral O₂ saturation was not statistically significant except in the pre session of foot reflexology. **In addition**, this table shows that there was a statistical significant difference between patients in both groups in relation to heart rate at the 1st,

2nd, 3rd days. While the differences was not statistically significant at the 5th& 7th postoperative days. **Furthermore**, in the 5th and 7th postoperative days, the mean arterial blood pressure of patients in both the study and control groups before the implementation of foot reflexology and routine hospital pain management was 76.60±2.70 & 75.40±1.73, 79.65±2.83 and 78.70±2.73 respectively.

Table (5):- Postoperative mean change of physiological parameters of both the study and control group of patients with solid tumor during the 1st three days of follow up (n=40).

Physiological parameters at postoperative days of follow up	The studied patients with postoperative solid tumor (n=40)		#Z value	P
	1. Mean change of respiratory rate.			
	Study group (n=20)	Control group (n=20)		
	Range Mean±SD	Range Mean±SD		
1 st day	↓4-↓1 ↓1.95±0.60	↓2-0 ↓1.30±0.57	3.263	0.001*
2 nd day	↓3-↓1 ↓1.95±0.51	↓3-0 ↓1.35±0.87	2.543	0.011*
3 rd day	↓3-0 ↓1.75±0.72	↓3-0 ↓1.30±0.73	2.046	0.041*
χ ² value P	1.550 0.461	0.456 0.796		
	2. Mean change of O ₂ saturation.			
1 st day	↓1-2 0.65±0.74	↓2-1 ↓0.35±0.93	3.225	0.001*
2 nd day	0-3 1.15±0.81	↓1-2 0.40±1.05	2.207	0.027*
3 rd day	0-2 1.20±0.69	↓1-2 0.60±0.88	2.156	0.031*
χ ² value P	5.698 0.058	10.088 0.006*		
	3. Mean change of heart rate.			
1 st day	↓10-↓1 ↓4±2.83	↓3-1 ↓1.55±1.32	3.512	0.001*
2 nd day	↓6-↓1 ↓3.35±1.50	↓4-1 ↓1.95±1.50	2.951	0.005*
3 rd day	↓6-↓1 ↓3.40±1.63	↓4-5 ↓1.35±2.20	2.156	0.031*
χ ² value P	0.329 0.848	1.104 0.576		

Study group=Patients received protocol of pain control by the researcher and under prescribed hospital pain management.

Control group=Patients received routine hospital pain management only.

*Significant (P<0.05)

Z value of Mann-Whitney U Test

χ² value of Friedman Test

Table (5):- Postoperative mean change of physiological parameters of both the study and control group of patients with solid tumor (n=40). (Continued)

Physiological parameters at postoperative days of follow up	The studied patients with postoperative solid tumor (n=40)		#Z value	P
	4. Mean change of systolic blood pressure.			
	Study group (n=20)	Control group(n=20)		
	Range Mean±SD	Range Mean±SD		
1 st day	↓19-20 3.80±9.36	↓5-5 ↓0.10±2.77	1.787	0.082
2 nd day	↓10-8 ↓2.85±4.87	↓5-1 ↓2.55±2.48	0.245	0.807
3 rd day	↓10-10 ↓3.05±7.34	↓10-5 ↓2.20±4.14	0.451	0.655
χ ² value P	7.763 0.021*	7.914 0.019*		
	5. Mean change of diastolic blood pressure.			

1 st day	↓6-10 0.40±5.30	↓5-5 ↓0.80±2.76	0.897	0.375
2 nd day	↓10-10 ↓1.15±5.01	↓5-5 ↓1.45±2.74	0.233	0.817
3 rd day	↓5-10 ↓1.95±4.95	↓5-1 ↓2.75±2.29	0.656	0.516
χ^2 value	2.000	4.290		
P	0.368	0.117		
6. Mean change of mean arterial blood pressure.				
1 st day	↓13-16 3.40±8.46	↓7-6 0.70±3.48	1.320	0.195
2 nd day	↓20-8 ↓1.70±6.44	↓10-6 ↓1.25±3.79	0.269	0.789
3 rd day	↓15-10 ↓2.10±5.21	↓5-10 0.55±3.69	1.856	0.071
χ^2 value	6.676	3.868		
P	0.036*	0.145		

Study group=Patients received protocol or pain control by the researcher and under prescribed hospital pain management.

Control group=Patients received routine hospital pain management only.

Z value of Mann-Whitney U Test

χ^2 value of Friedman Test

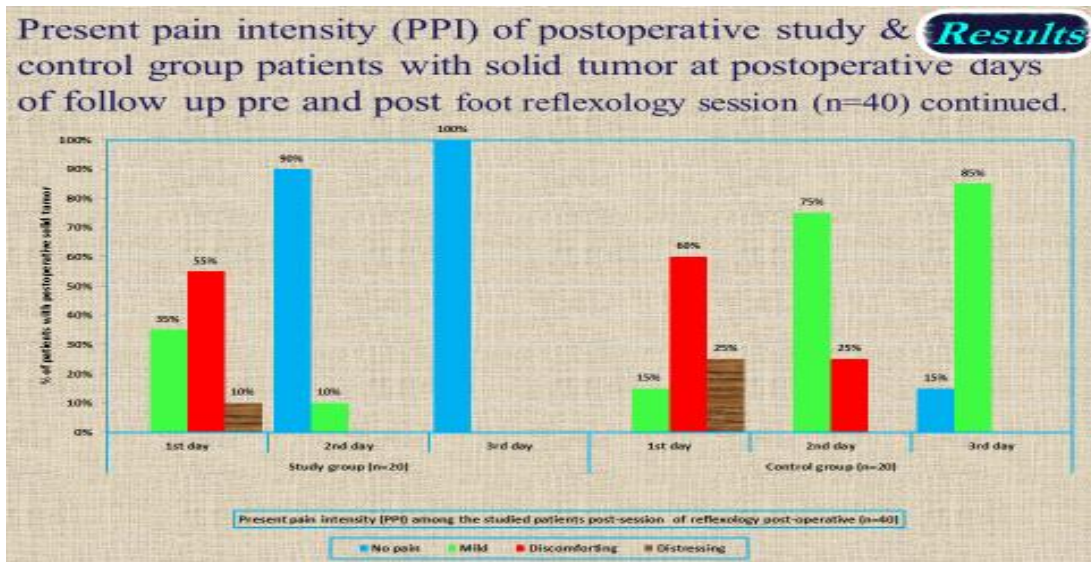
Table (5):- Postoperative mean change of physiological parameters of both the study and control group patients with solid tumor This table presents there was a significant decrease in **respiratory rate** among the study group in comparison to the control group at the first three days of the follow up where Z value= 3.263, 2.543 and 2.046 at P value= 0.001 , 0.011 and 0.041 respectively. **Also, regarding the mean change of O₂ saturation** there was a statistically significant difference between the first three days of the follow up of the control group where $\chi^2=10.088$ at p value= 0.006. **In relation to the mean change of heart rate**, there was a significant decrease in the heart rate among the study group in comparison to the control group at three days of follow up where Z value=3.512, 2.951 and 2.156 at P value= 0.001, 0.005 and 0.031 respectively. **While** there was no statistical significant difference between the mean changes of mean arterial blood pressure among patients of both the study and control.

Table (6):- Present Pain Intensity (PPI) of postoperative study and control group patients with solid tumor at postoperative days of follow up pre and post foot reflexology session (n=40).

Description of PPI at postoperative days of follow up		The studied patients with postoperative solid tumor (n=40)																			
		Study group (n=20)										Control group (n=20)									
		1 st day		2 nd day		3 rd day		5 th day		7 th day		1 st day		2 nd day		3 rd day		5 th day		7 th day	
		n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Pre-session	No pain	0	0	0	0	15	75.0	19	95.0	20	100	0	0	0	0	0	0	5	25.0	20	100
	Mild	0	0	5	25.0	2	10.0	1	5.0	0	0	0	0	0	0	3	15.0	15	75.0	0	0
	Discomforting	0	0	11	55.0	3	15.0	0	0	0	0	0	0	0	0	16	80.0	0	0	0	0
	Distressing	0	0	4	20.0	0	0	0	0	0	0	0	0	20	100	1	5.0	0	0	0	0
	Horrible	13	65.0	0	0	0	0	0	0	0	0	10	50.0	0	0	0	0	0	0	0	0
Post-session	Excruciating	7	35.0	0	0	0	0	0	0	0	0	10	50.0	0	0	0	0	0	0	0	0
	No pain	0	0	18	90.0	20	100	0	0	0	0	3	15.0								
	Mild	7	35.0	2	10.0	0	0	3	15.0	15	75.0	17	85.0								
	Discomforting	11	55.0	0	0	0	0	12	60.0	5	25.0	0	0								
	Distressing	2	10.0	0	0	0	0	5	25.0	0	0	0	0								
T^* (Study vs control)	Pre	0.921	26.667	25.095	20.417	0.000															
	Post	0.337	0.0001*	0.0001*	0.0001*	1.000															
P		2.933	32.941	26.199																	
		0.231	0.0001*	0.0001*																	
T^* (pre vs post)		25.741	34.291	5.714																	
		0.0001*	0.0001*	0.057																	
P		15.000	40.000	29.805																	
		0.0005*	0.0001*	0.0001*																	

*Significant (P<0.05)

Table (6):- Present Pain Intensity (PPI) of postoperative study and control group patients with solid tumor at postoperative days of follow up pre and post foot reflexology sessionIn the 3rd postoperative day, it was noticed that all patients 100% in the study group had no pain after the implementation of foot reflexology and routine hospital pain management, compared to only a minority 15% of patients in the control group. In the 5th day, it was found that majority 95% of the patients in the study group had no pain, compared to a quarter 25% of patients in the control group pre foot reflexology session.



(Figure 1) Present Pain Intensity (PPI) of postoperative study and control group patients with solid tumor at postoperative days of follow up pre and post foot reflexology session (n=40).

(Figure 1) Shows that present pain intensity (PPI) of postoperative study and control group patients with solid tumor at three postoperative days of follow up post foot reflexology sessions. A statistical significant difference were present between both the study and control groups in relation to the present pain intensity at 1st, 2nd and 3rd post postoperative days

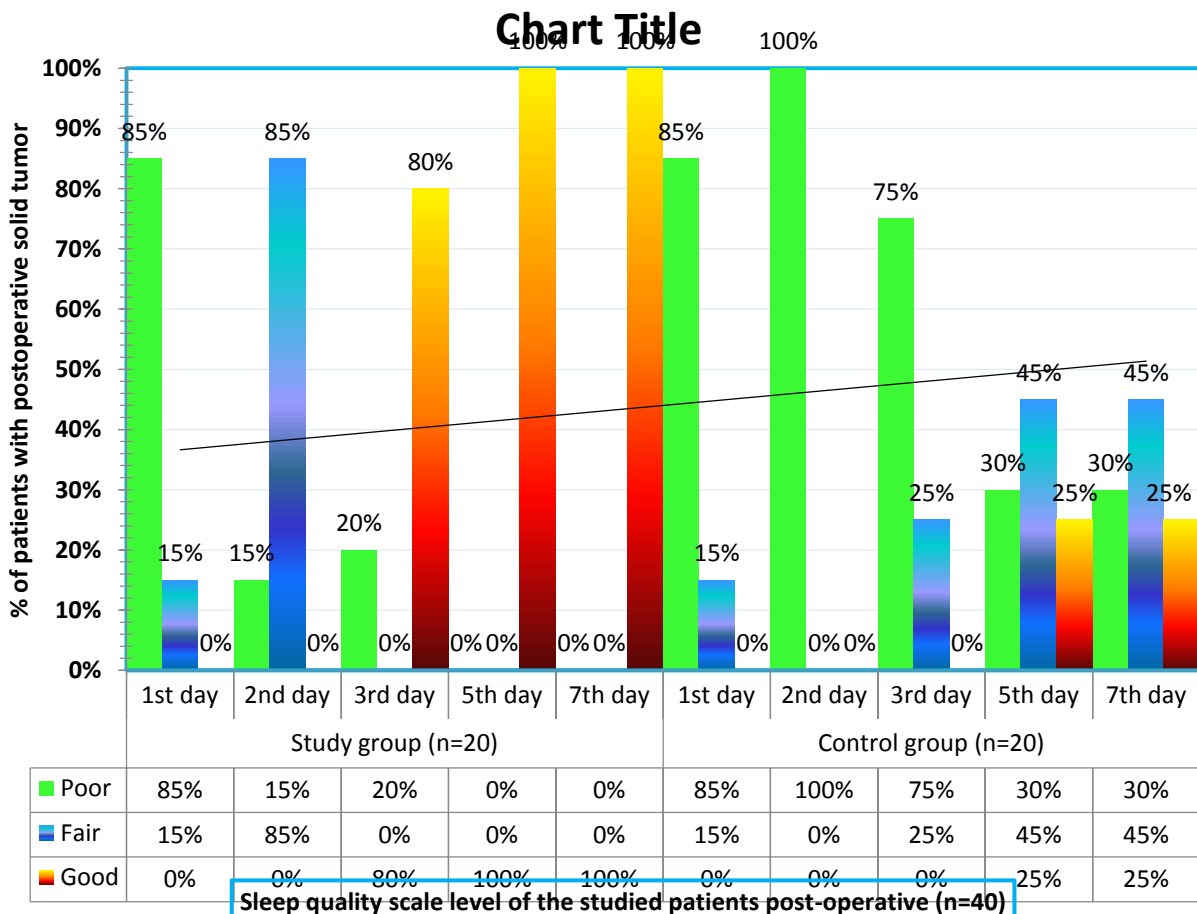


Figure (2):- Quality level of postoperative sleep of both the study and control group patients with solid tumor post the implementation of protocol of pain control at postoperative days of follow up (n=40).

Figure1 (2): shows the Quality level of postoperative sleep of both the study and control group patients with solid tumor post the implementation of protocol of pain control at postoperative days of follow, the majorities 85% & 85% of the patients of the study and control groups have a poor sleep while in the 2nd postoperative day, it was found that minority 15% of patients of the study group had a poor level of sleep quality, compared to 100% of patients in the control group. On the other hand, 0% in the study group reported a poor sleep quality while 30% in the control group reported a poor sleep quality in the 5th and 7th postoperative days respectively. In the 5th and 7th postoperative days, all patients 100% in the study group reported a good sleep, compared to a similar proportion 25% of patients in the control group.

Table (7):- Relationship between the postoperative present pain intensity (PPI) and sleep quality post foot reflexology session of both the study and control group of patients with solid tumor at the 1st three days of follow up (n=40).

Description of present pain intensity(PPI) at postoperative days of follow up		Sleep quality scale level of the studied patients with postoperative solid tumor (n=40)									
		Study group (n=20)						Control group (n=20)			
		Poor		Fair		Good		Poor		Fair	
		n	%	N	%	n	%	N	%	n	%
1 st day	Mild	7	41.2	0	0	0	0	3	17.6	0	0
	Discomforting	8	47.1	3	100	0	0	10	58.8	2	66.7
	Distressing	2	11.8	0	0	0	0	4	23.5	1	33.3
	Total	17	85.0	3	15.0	0	0	17	85.0	3	15.0
χ^2		2.888						0.654			
P		0.236						0.721			
2 nd day	No pain	3	100	15	88.2	0	0	0	0	0	0
	Mild	0	0	2	11.8	0	0	15	75.0	0	0
	Discomforting	0	0	0	0	0	0	5	25.0	0	0
	Total	3	15.0	17	85.0	0	0	20	100	0	0
χ^2		0.392						-			
P		0.531									
3 rd day	No pain	4	100	0	0	16	100	1	6.7	2	40.0
	Mild	0	0	0	0	0	0	14	93.3	3	60.0
	Total	4	100	0	0	16	100	15	75.0	5	25.0
χ^2		-						3.268			
P		-						0.071			

Study group=Patients received protocol of pain control by the researcher and under prescribed hospital pain management.

Control group=Patients received routine hospital pain management only.

Table (7):- Relationship between the postoperative present pain intensity(PPI) and sleep quality of both the study and control group of patients with solid tumor at the 1st three days of follow up post foot reflexology session (n=40). This table presents that there was no statistical significant correlation between sleep quality & pain intensity post session of both the study and control groups at the postoperative first three days of follow up.

VI. Discussion

Patients with solid tumors develop severe pain especially in the first hours postoperative. This pain can be exacerbated during rest by simple things such as tight dressings, tight bedding and immobility, swelling of parts of the body as a result of illness or the surgery, multiple intravascular cannulations, nursing and medical intervention. Also, turning and moving have been documented as being the most painful procedures that critically ill patients undergo (38, 39).

In the current study biosociodemographic characteristics of the patients revealed that, the most common age group among patients of both studied groups was between fifth and sixth years. This could be attributed to most people in their late 60s or older; their risk for cancer is increased. Majority of studied patients were in the fifth decade of life, this result was supported by a study results was done by **Mohamed (2015)** (40), revealed that the majority of studied patients were in the fifth decade of life. **In relation to sex**, it is generally accepted that males and females respond differently to painful conditions. The present study showed that more than half of patients in both study and control groups were males. This finding was contradicted with a study results was

done by **Tsayet. al, (2008)** ⁽⁴¹⁾, found that more than half of the studied patients were females. **Moreover**, the present study found that more than half of patients in both studied groups were illiterate. The main causes of this factor are lack of knowledge regarding to safety precautions that decrease risks of taking medications and methods for living healthy life.

Concerning previous hospitalization, the current study showed that about three quarters of patients in both study and control groups were previously hospitalized. This is due to , patient`s previous hospitalization and previous pain experience will often influence their reactions as coping mechanisms that were used in the past will affect their tolerance to the pain in the present.

Regarding past medical and surgical history, the present study revealed that most patients with solid tumors in study and control groups had history of previous surgery as patients who had previous history of surgery could expect lower intensity of postoperative pain than the patients who had not previous history of surgery it may be due to that patients who had previous surgery could expect the intensity of pain that may be they will suffer, and become more able to coping with it. **Mohamed (2015)** ⁽⁴⁰⁾ did this finding in contrast with a study results revealed that the minority of studied patients underwent previous surgery.

As regards to effect of pain on daily living activities, the majority of study and control groups were affected in their performance of daily living activities and they felt burning and colicky pain during daily living activities preoperatively. Also, the current study showed that pain affected the patient`s personal hygiene in the majority of the control group and the minority in the study group. Moreover , Regarding the gastrointestinal symptoms associated with pain that occur during performance of activities of daily living, the present finding showed that vomiting and burning sensation in stomach were presented between the majority of the study group as well as the control group preoperatively.

Concerning to effect of pain on sleep pattern, the results of the present study showed that more than half of the study group have no insomnia during sleep compared to half in the control group. Additionally, more than half of the studied patients did not do anything to help them to sleep. Moreover, the current study revealed that the majority of the study and control group had no dyspnea during sleep and the majority of both groups had no pain while changing position during sleep preoperatively. **Ahmed (2013)** ⁽⁴²⁾, was contrast with the present study and reported that most common sleep disturbances among all subjects are insomnia, hypersomnia and sleep related breathing disorders, also, added that a statistical significant correlation between medical diagnosis and the presence of sleep disturbance.

In relation to use of analgesics throughout the period of the study, the current study revealed that a significant decrease in the use of analgesic in the study group. On the other hand, the finding showed that the majority of patients in the control group were administered analgesics throughout the post-operative days compared to the patients in the study group. This finding was in line with a **Tsayet. al, (2008)** ⁽⁴¹⁾, found that study group patients received significantly less opioid analgesics than the control group. On the other hand, this finding was contradicted with a study results was done by **Hagaget. al, (2014)** ⁽⁴³⁾, reported that no significant reduction in the use of analgesic medication was present between study and control groups.

In relation to respiratory rate, the present study revealed that patient`s respiratory rate significantly decreased toward normal post sessions of foot reflexology than pre sessions in each day of application in the study group than control group from the 1st to 7th day postoperatively. This finding was contradicted with **Moeiniet. al, (2011)** ⁽⁴⁴⁾, found no significant changes were observed for respiratory rate among coronary artery bypass surgery patients, after applying foot massage.

As regards to the effect of foot reflexology on the heart rate, there was a statistically significant reduction in the heart rate toward normal from the 1st to 7th day postoperatively after the intervention than before the intervention in the study group than control group. This finding was in line with a study results was done by **Hagaget. al, (2014)** ⁽⁴³⁾, reported a significant decrease in heart rate and respiratory rate after application of foot massage for postoperative breast cancer patients. On the other hand, this finding in contrast with a **Jones et. al, (2011)** ⁽⁴⁵⁾, they reported that no significant difference noted in the heart rate.

Concerning to oxygen saturation, the current study showed a statistically significant improvement in oxygen saturation post sessions of reflexology than pre sessions in study group than control group from the 1st to 7th day postoperatively; this may be due to deep breathing taken by patients during the intervention. This finding was in line with a study results about "Effect of 'foot massage and reflexology' on physiological parameters of critically ill patients." was done by **Kauret. al, (2012)** ⁽⁴⁶⁾, found a statistically significant improvement in oxygen saturation level in the second, third and average observations. This finding contradicted with a **study results** was done by **Wilkinson et. al, (2006)** ⁽⁴⁷⁾, reported that oxygen saturation level didn`t change significantly when oxygen saturation measured at the beginning and end of each foot massage session.

As regards to the mean blood pressure (MBP); the present study reported a significant decrease in the means of blood pressure post sessions of foot reflexology than pre sessions in study group than control group from the 1st to 7th day postoperatively. This finding congruent with a study results was done by **Hagaget. al, (2014)** ⁽⁴³⁾, and **Moeini et. al, (2011)** ⁽⁴⁴⁾ reported a significant decrease in blood pressure after application of

foot massage and reflexotherapy among the patients`This finding was in contrast with a study results was done by **Jones et. al, (2011)**⁽⁴⁵⁾, they found that no significant difference noted in Diastolic, Systolic blood pressure and Mean blood pressure. Finally, these changes in respiratory rate, oxygen saturation, heart rate and mean blood pressure may be due to effect of relaxation shown after applying reflexology for each foot, and the increasing level of relaxation at the end of the session. **Hayes et. al, (1999)**⁽⁴⁸⁾, indicated that the role of the parasympathetic nervous system that stimulated as effect of massage treatment which resulted in decreased physiological responses; heart rate, mean arterial blood pressure and respirations indicative that the patients were feeling more relaxed.

Another idea touch, mainly in the form of therapeutic massage, has been shown to reduce the levels of the stress hormones, cortisol and noradrenaline (norepinephrine),⁽⁴⁸⁾ this lead to decreased physical activation. **Machiet. al, (2000)**⁽⁴⁹⁾ they, reported that foot massage applied as pressure on specific points on foot sole produced relaxation as appeared through the reduction in physiological activation.

Regarding the present pain intensity (PPI), the findings of the present study showed that all patients in the control group reported higher pain intensity before and after taking analgesic in the 1st postoperative day compared to the study group showed a highly improvement in pain intensity throughout the period of the study and showed no pain after the last session in the 3rd postoperative day. This improvement in the pain intensity may be due to the application of foot reflexology by the researcher. **The present study finding was in the same line with Hagaget. al, (2014)**⁽⁴³⁾, reported that 20 minutes of foot massage intervention significantly reduced postoperative pain intensity levels within the first and second hour.⁽⁵⁰⁾ Additionally, **Rosenberg (2001)**⁽⁵¹⁾, found that sleep pattern after major surgeries was disturbed due to trauma, surgical stress response and opioid administration.

This result was supported by Wright et. al, (2002)⁽⁵²⁾, they reported that patient`s perceptions about receiving foot reflexology improved their sleep. Also, **Atkins & Harris (2008)**⁽⁵³⁾, they found that the use of foot reflexology in managing stress and the subjects felt well and their sleep had improved. **On the other hand, YenLiet. al, (2011)**⁽⁵⁴⁾, mentioned that, participants in the intervention group received 15 minutes of foot reflexology on each foot for a total of 30 minutes once each day for five consecutive days at the same time in the evening and the results significantly improved their quality of sleep.

Concerning relationship between pain intensity and patient`s sleep quality, the current study revealed that the majority of patients reported a reduction in pain score and improvement in sleep quality post foot reflexology application throughout the period of study. patient`s sleep was affected by postoperative pain, this may be attributed to the etiology of impaired sleep can be multifactorial, the activation of specific and non-specific immunological pathways interferes with the regulation of sleep and wakefulness in postoperative pain. In addition, the inflammatory process plays a central role in sleep modulation resulting in insomnia⁽³⁴⁾. **The present study finding was in the same line with Jeongsoonet. al, 2011**⁽⁵⁵⁾, reported a significant correlation between fatigue, sleep and pain.

According to the present study findings, the application of foot reflexology had a positive impact on participants' pain scores, sleep quality, and physiological parameters throughout intervention phases. These improvements may be attributed to the process of reflexology as it has been claimed that local finger pressure on reflex points on the feet can influence the function of corresponding target organs to promote homeostasis, relaxation, and sense of human touch. Therefore, it has been recommended as a promising complementary therapy which can improve quality of life in persons with stomach and colon cancer, and other conditions⁽⁵⁶⁾.

The present study concluded that foot reflexology which is cheap, natural measures of pain relief was highly minimizing post-operative pain; improve quality of sleep and physiological parameters. As we are a developing country with a limited facility and limited hospital beds, this method can be utilized by all critical care nurses during postoperative period as a successful measure for incisional pain relief rather than pharmacological methods. Also, **Rashaet. al, 2019**⁽⁵⁷⁾, concluded that children with cerebral palsy who received reflexology exhibit improvement in their bowel functions. Moreover, foot reflexology method is cost effective and it has high efficacy because it is inexpensive and it has no harm to the patient`s health⁽⁵⁸⁾. Post Mastectomy." was done by **Ahmed (2013)**⁽⁴²⁾, reported that the most common sleep disturbances among all subjects are insomnia, hypersomnia (excessive sleepiness), sleep related breathing disorders, and sleep-related movement disorders e.g. restless leg syndrome, periodic limb movement disorder.

VII. Conclusion

Based on the results of this study, it could be concluded that, the physiological responses to postoperative pain after solid tumor surgery as respiratory rate, heart rate, systolic bloodpressure, diastolic blood pressure and mean arterial blood pressure were decreased and O₂ saturation increased among the study group.

- The intensity of pain is measured by present pain intensity (PPI) was decreased after the application of foot reflexology among the study group.
- Also, the intensity of sensory and affective indicators are measured by McGill pain scale was decreased.

-The quality of sleep is measured by Groningen sleep quality scale was also improved after the application of foot reflexology among the study group.

-Therefore, the application of foot reflexology is effective and had a positive effect on reducing pain, improving physiological parameters & sleep.

VIII. Recommendations

-Intensity of patient`s pain should be assessed by using different scales and documented daily at regular intervals in patient`s record.

-Protocols for foot reflexology should be available in the hospital and should be carried out immediately after surgery.

-Development of in-service training program for nursing staff in intensive care units about safe practice of foot reflexology.

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