https://menj.journals.ekb.eg
Print ISSN: 2735-3974
Online ISSN: 2735-3982
DOI: ----------

MNJ
Menoufia Nursing Journal
Faculty of Nuring
Menoufia University

Effect of Pre-operative and Intra-operative Nursing Intervention on Surgical wound Infection among Surgical Patients

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Abstract: Background: Surgical wound infection is a serious complication of surgical procedures. **Purpose** was to evaluate the effect of preoperative and intraoperative nursing intervention on surgical wound infection among surgical patients**. Design** A quasi-experimental design was used to achieve the purpose of the study. **Sampling:** Consecutive samples of 110 adult patients undergoing surgical procedure were selected and divided alternatively and randomly into two equal groups: 55 patients in each group. **Setting**: Study was carried out at Outpatient general surgery clinic, General surgical department and operating theatre of Menoufia University Hospital. **Instruments of the study:** Three instruments were used for collecting necessary data (structured interview questionnaire, biophysiological measurements, and Bates-Jensen wound assessment instrument. **Results:** 10.9% versus 36.4% respectively of the study and control group had surgical wound infection. **Conclusions:** preoperative and intraoperative nursing intervention was effective in prevention of surgical wound infections. **Recommendations:** preoperative and intraoperative nursing intervention should be applied to prevent surgical wound infection.

Key words: *preoperative and intraoperative nursing intervention, surgical wound infection.*

Introduction

Surgical wound infection is a serious complication of surgical procedures and the most common type of healthcare-associated infections (HAIs) in low- and middle-income countries. Surgical site infection happens in up to 30% of surgeries, represent 14% of HAIs. (Patil et al., 2018 and WHO, 2018).

Most surgical wound infections associated with many complications. Surgical wound infections impose significant burden to the patient and all health care system through prolonged hospital stays, spend time in an intensive care unit, readmission to hospital, long-term disability may occur, contribute to spread of antibiotic resistance with prolonged antibiotic consumption, increase treatment period, substantial financial burden to health care systems, high costs for patients and families, deterioration in the quality of life, and unnecessary deaths. (World Union of wound healing societies 2016).

Surgical site infections (SSIs) are categorized into superficial, deep, and organ space. Incisions may be infected by the patient's own normal flora or by flora from the environment, including the operative team. Superficial incisional surgical site infections (SSI) involve only the skin and subcutaneous

tissue of incision. Deep incisional SSI involves deep tissues, such as fascia and muscle layers. Organ/space SSI involves any part of the surrounding anatomy such as pertinent organs or spaces. (Viehman et al., 2016)

Risk factors contain patient-related (endogenous) and process/procedural related (exogenous) variables that affect a patient's risk of developing surgical wound infection. Some variables are obviously not changeable, such as age and gender. However, other potential factors can be improved to increase the likelihood of a positive surgical outcome, either contamination originates from the patient, for example, when microbes on the skin enters a wound, bad nutritional status, tobacco use and poor skin preparation. Or from the surrounding environment, operating staff, and operating theatre. (Meng et al., 2015)

The usual presentation of infected surgical wounds can be characterized by signs of infection: Pus or drainage, bad smell coming from the wound, systemic fever, chills, local hotness, local redness, Pain, and positive wound culture. Staphylococcus aureus, Coagulase-negative Staphylococci, Enterococcus, and Escherichia coli remain the most frequently infected pathogens of surgical site infections. (Espinosa and Sawyer, 2020).

Surgical site infection prevention is a vital issue in both high and low-income nations, the prevention of surgical complications is based on the awareness of health care professionals, especially nurses about evidence-based practices to provide high-quality nursing care. Many interventions are used by the target of decreasing the risk of SSIs in people undergoing surgery. These interventions can be largely delivered at preoperative and intraoperative. (Gillespie et al., 2015 and Berríos-Torres et al., 2017).

Preoperative nursing preparation of patients for surgery aiming at preventing postoperative SSIs that based on appropriate skin care, shaving surgical site only if needed, showering with chlorhexidine 4% soap in day before and on the day of an operation, smoking cessation, nutrition education, and stress management. (De Jonge et al., 2017; National institute for health and clinical excellence, 2019; and World health organization, 2019).

The intraoperative nursing interventions are mainly focused on use of standard and incise drapes, use of masks, hair covers, gowns and other protective coverings for theatre staff, double colorful gloving, maintenance of normothermia to the patient in the operating room by the use of warming devices or blankets, maintaining oxygenation in adult patients undergoing general anesthesia with endotracheal intubation during surgery, wound irrigation (including use of intraoperative antibiotic wound irrigation before wound closure), wound closure methods by using antimicrobial sutures, and theatre traffic control (protocols for managing the movement of people in theatre). Other interventions focused on SSI prevention may be intended at the surgical environment, ventilation and cleaning. (De Jonge et al., 2017; National institute for health and clinical excellence, 2019; and World health organization, 2019).

Nurses are significant individuals of the surgical care team, who remains about 24 hours with the patient. It is greatly vital for surgical nurses to completely understand the basics of pre and intra-operative surgical wound infection prevention and control methods. It is estimated that nurses can avoid 25 percent of infections by actualizing standard safety measures during the care of surgical patients. Besides, the nurses can help prevent

SSI, reduce the financial burden of patients and hospital costs, and improve patients' quality of life by applying evidence-based knowledge and prescribed practices. Therefore the present study was conducted to evaluate the effect of preoperative and intraoperative nursing intervention on prevention of surgical site infection. (Sickder et al., 2017).

Significance of the study

Surgical wound infections are the most common hospital-acquired infections (HAI). SSIs lead to increased morbidity, reoperation, and readmission to the hospital, poorer outcomes, and increased costs. Many prevention strategies are proposed for preoperative, intraoperative to reduce surgical site morbidity. Surgical site infections (SSIs) have been shown to consist of up to 20%to 40% of all of the healthcare-related infections worldwide. At least 5% of patients undergoing a surgical procedure, complain from a surgical wound infection. (Ding et al., 2016).

The incidence of surgical wound infection is approximately 160,000 to 300,000 cases annually in the United States (US). The financial burden of SSI is substantial and is one of the costliest of all hospital-acquired infections. Estimated costs vary from $3.5 to $10 billion in the US. Moreover, SSI's increase in emergency department visits, readmissions, and extends hospital stays, by 9.7 days per infection. An estimated 60 percent of SSIs are projected to be preventable with the use of evidence-based measures. (Ban et al., 2017).

In Egypt, Out of 495 patients 126 (25.45%) patients developed SSI. Out of 126 SSI patients only 105 patients (83.33%) had positive swab/pus culture reports Methicillin-sensitive Staphylococcus aureus (MSSA) was the most common isolated organism in the positive cultures (51/105 patients) (48.57%), followed by Escherichia coli (E-coli) (30/105 patients) (28.57%). The percentage of gram-positive bacteria in cultures was (87/105) (82.86%) while gram negative bacteria was (51/105) (48.57 %), the anaerobic bacteria percentage was (12/105) (11. 43 %), multiple growth was detected in (33/105) (31.43%). (Algazar et al., 2020)

The prevalence of SSI at Menoufia University Hospitals was found to be 67.6%. The most common type of operative wounds was contaminated wounds and the most common wound infections were superficial wounds. (Zahran et al., 2017)

Wound contamination can be prevented by implementing certain guidelines from the nurses and other health care workers, such as all staff complying with preventing SSI guidelines, including hygienic practices and correct cleaning of the operating room between operations are examples of measures that can reduce SSI load in all health care facilities (Liu, 2018)

SSI prevention starts with proper patient selection and optimization of medical conditions, particularly smoking cessation, preoperative warming of patients and patient skin preparation by using chlorhexidine 4% and hair removal when indicated to prevent SSI. Additionally, vitamin E, and herbal supplements, help reduce infection, morbidity, and mortality rates (Paul et al., 2016). Kerri et al. 2017 Reported that Patients who received preoperative intervention had a 2.7% SSI rate compared with 15.8% ho didn't receive preoperative nursing intervention ($p < 0.001$) and added that prevention of SSIs achieved by several methods, including optimized preoperative patient preparation, proper tissue handling during operation, adequate intraoperative oxygen delivery, wound irrigation, and

maintenance of intraoperative normothermia,

Purpose of the Study

The purpose of the current study is to assess the effect of preoperative and intraoperative nursing intervention on prevention of surgical wound infection among surgical patients.

Research Hypotheses

Patients who receive the pre-operative and intra-operative nursing intervention (study group) will have decreased surgical wound infection rates than patients who don't receive (control group).

Methods

Research design:

A Quasi-experimental research design was utilized in this study (study &control group).

Setting:

The study was carried out at the outpatient general surgical clinic, general surgical department, and operating theater of Menoufia University Hospital.

Study sample:

A consecutive sample of 110 adult patients of both genders was divided alternatively into two equal groups, 55 patients in each group.

Study group: 55 patients (received preoperative and intraoperative nursing intervention).

Control group: 55 patients (received only routine hospital care).

Sample size calculation:-

To calculate the required sample size, we used the Epi website**.** The assumptions of this study were:

- A two-sided confidence level of 95%: (1- α).
- A power (1- β) or (% chance of detecting) of 80%.
- Ratio of sample size, unexposed (control) / exposed (study group) = 1
- % of unexposed with the outcome (prevention of surgical site infection)= 25%
- Then we entered one of two parameters which were the least extreme Odds Ratio = 2 to be detected, and the other parameter would be calculated by the Epi website program using the following formula:

$$N=\frac{\left(Z_{\alpha/2}\sqrt{2p(1-p)}+Z_{1-\beta}\sqrt{P_1(1-P_1)P_2(1-P_2)}\right)^2}{(P_1-P_2)^2}$$

Where P1 and P2 are the proportion of event of interest (outcome) for group I and II, and $p = \frac{(P_1+P_2)}{2}$ $Z_{\alpha/2}$ is normal deviate at a level of significance and $Z_{1-\beta}$ is the normal deviate at 1-β% power with β% of type II error, normally type II error is considered 20% or less. (Epi website, 2019).

- Results were presented using the methods of Kelsey, Fleiss, and Fleiss with continuity correction. We used the Fleiss method with 53 surgical patients as a group I (study group), and another 53 surgical patients as group II (control), with a total sample size of 106 surgical patients. To safeguard against the reluctance of some surgical patients in the follow-up visits, we approximate the sample size to 55 in each group, with a total sample size of 110 surgical patients. (Fleiss and Kelsey 2007)

Inclusion criteria:

The study subjects were selected according to the following criteria:

- Adult patients.

Exclusion criteria:

- Diabetic patient: marked Hyperglycemia has been shown to cause an increased risk of surgical wound infections.
- Patients who have malnutrition as anemia. Preoperative anemia (POA)

was an independent risk factor for incision surgical wound infection.

- Patients who have uremia that associated with fluid, electrolyte, hormone imbalances, and metabolic abnormalities have been shown to cause an increased risk of surgical wound infections.

Instruments of the study

For collecting the necessary data and accomplishing the goal of the study, three instruments were utilized by the researcher. These instruments were as follows:

Instrument one: Structured interview questionnaire.

It was developed by the researcher to assess characteristics o. It contained two parts.

- **Part one:** Sociodemographic data:

It was comprised of questions related to the patient's age, gender, marital status, educational level, residence, occupation, and smoking.

- **Part two:** Medical data

It was comprised of questions about past and present medical histories such as past surgeries, past surgical complications, chronic diseases, type of present surgery, and duration before surgery.

Instrument two: Biophysiological measurements

It was developed by the researcher to assess

A. The wound swab was taken on the day of operation when the patient was on the surgery table immediately after closure of the subcutaneous layer and before skin closure to determine type of microorganism if present.

B. Post-operative wound swab that is taken during the first dressing postoperative to determine type of microorganism if present.

C. Vital signs measurement intraoperative and postoperative during first dressing.

D. Signs and symptoms of surgical wound infection during first dressing.

Instrument three: Bates-Jensen Wound Assessment Tool

It was developed by Barbara Bates-Jensen (2007). And it is now known as the Bates-Jensen Wound Assessment Tool. The Bates-Jensen Wound Assessment Tool (BWAT) is a valid and reliable instrument used to assess the wound status. This instrument was modified by the researcher to accommodate the criteria of the wound and to be appropriate. The researcher use Eight parameters of it, which include size (5 items), Depth (6 items), edges (6 items), exudates type (5 items),exudates amount (5 items), skin color surrounding the wound (5 items), peripheral tissue edema (5 items), peripheral tissue induration (5 items).

Scoring system

Each item can be scored from1 to 5 except depth and edges scored from 0 to 5, with 1 being the best for that attribute. After each item is assessed and scored, the subscores are summed to get a total score.

- Tissue is healthy 1-8
- Tissue regeneration 9-35
- Tissue degeneration 36-40

An additional asset of BWAT is using the score to measure wound severity. This is important since the goal of wound care is to reduce wound severity. The total BWAT scores are divided into four severity categories:

- A score from 8–13 indicated minimal severity.
- A score from 14–19 indicated mild severity.
- A score from 20–25 indicated moderate severity.

- A score from 26–40 indicated extreme severity.

Validity of the tools

All instruments were tested for expression of content validity by a jury of five experts in the field of medical surgical nursing and the general surgery to ascertain the accuracy and completeness of instruments. Two professors in general surgery department, Faculty of Medicine, Menoufia University, and Three professors in medical surgical Nursing, Faculty of Nursing, Menoufia University were selected to revise the instruments and ascertain their relevance and completeness, and all modifications were incorporated and taken into consideration.

Reliability of the instruments

The reliability of instruments was done to determine the extent to which items in the instruments were related to each other by Cronbach's Co-efficiency Alpha for instruments one(a= 0.97).For instrument two test retest reliability was (r= 0.84). So, it can be concluded that all instruments have adequate levels of reliability.

- **Written approval**

An official letter was submitted from the Faculty of Nursing to the responsible authorities (manager and head nurse) of Menoufia University Hospital to conduct this study, then an ethical approval was obtained after an explanation of the aim of the study.

Data collection

Ethical considerations:

A written approval was obtained from the Faculty of Nursing Ethical and Research Committee to carry out the study, . All patients were informed of the purpose of the study and that they were free to decide whether or not to participate in the study. Then, a written informed consent was obtained from each patient. Confidentiality was done by ensuring the anonymity of patients.

Pilot study

A pilot study was carried before data collection on 10% of the study sample (11) patients to evaluate the instruments for clarity, applicability, relevance, and feasibility of the tools as well as to estimate the time needed for data collection then necessary modifications were carried out. Pilot study sample were excluded from the current study.

Procedure:

An official letter was submitted from the Dean of the Faculty of Nursing to the directors of selected settings containing the purpose and methods of data collection.

- Data were collected over 6 months extended from the beginning of December 2020 to the end of June 2021.
- Each subject of both groups was interviewed individually by the researcher.
- The included subjects were randomly divided alternatively into two equal groups (55 patients in each group):

- **Study group:** 55 patients received preoperative and intraoperative nursing intervention.
- **Control group:** 55 patients received only routine hospital care.

- Firstly data was collected from the control group, then the study group to avoid contamination of data collection.
- The purpose of the study was explained to each subject in both groups.
- The data collection was carried out in four consecutive phases assessment phase, planning phase, implementing phase, and evaluation phase.

- **Assessment phase**

This phase aimed to assess the patient's baseline data to be a guide for comparison.

- Both groups were interviewed to assess their characteristics using the first instrument.
- Every patient in the study group was interviewed individually by the researcher between 8 am and 12 pm for 10 minutes at the general surgery outpatient clinic.
- Every patient in the control group was interviewed individually by the researcher between 8 pm and 12 pm for 10 minutes at the general surgery department.

- **Planning phase**

1) Booklet was prepared by the researcher which included preoperative health education about smoking cessation, nutritional support, and stress management .Teaching videos were used for more explanation .
2) Booklet also includes intraoperative evidence-based measures for the patient, staff, and environment to prevent intraoperative wound infection.

- **Implementing phase**

(For the study group)

In this phase, each patient of the study group was interviewed individually.

A) <u>Preoperative preparation</u>

A. During the first session, patients in the study group were interviewed in the outpatient clinic , and the session took about 30-45 minutes, by using booklet prepared by the researcher and the following preoperative preparations were discussed

1) Smoking cessation four to six weeks before the surgery date if the patient was smoker.
2) Nutritional needs should be met through adequate intake of carbohydrates, protein, amino acids, vitamins and mineral supplements critical in wound healing and prevent surgical site infection (SSI).
3) Stress reduction measures should be applied through discussing patient's fears about surgical procedures, hearing favourite music, reading the holy Quran.

B. During the second session, patients in the study group were interviewed the day before the surgery in the general surgical department, and that session took about 30-45 minutes which discussed preoperative preparation in the booklet

1) A preoperative skin antisepsis protocol for surgical patients that include a shower regimen with chlorhexidine gluconate 4% at least twice before surgery should be followed.
2) Hair removal was avoided if possible, however, clipping hair was recommended over shaving, outside of the operating theatre.
3) Warming devices are advised such as using blankets and heavy clean clothes
4) Stress management is done by discussing the patient's fears about surgical procedures, hearing favourite music, reading the holy Quran.

B) <u>Intraoperative preparation</u>

During the third session intraoperative nursing care is as follows:

1- For patient

- Maintenance of normothermia of the patient by using active warming devices such as administration of warm intravenous fluids warmed by Ranger warming fluids, cover rest of the body away from the surgical site and measure body temperature at appropriate intervals.
- Monitor vital signs during surgery by the monitor.

- Check oxygen saturation to optimize tissue oxygenation of the patient.
- Normovolemia hemodynamic goal-directed therapy is recommended to reduce surgical wound infection by measuring intake and output.
- Intra-operative wound irrigation (IOWI) with antibiotic wound irrigation such as Gentamicin ampoule with normal saline for up to 3 minutes is an effective and cost-effective method for the reduction of surgical wound infection.
- A swab from wound intraoperative can be taken immediately after subcutaneous closure and before skin closure for the study group.
- In the ancillary recovery room a follow-up of patient oxygenation and vital signs are done.

2-For staff

The researcher observe the measures taken by the nursing staff to prevent SSIs

- Surgical hand hygiene
- Wearing double colourful gloving significantly reduces glove perforations
- Wearing surgical protective PPE

3-For environment

- Traffic control and all individuals who enter the semi-restricted and restricted areas should use personal protective equipment (PPE) and follow the aseptic technique.
- Proper theatre ventilation.
- Accurate disinfection is important operations to reduce bacterial load and reduce risk SSIs.

c)Postoperative nursing measures

During the fourth session that took about 10-15 minutes patients in the study group were interviewed in the general surgical department and other patient in the outpatient general surgery clinic. The researcher performed the following:

- Measuring vital signs before first dressing.
- Took swab from the wound during first dressing.
- Assessment of clinical manifestation of wound infection

- **Evaluation phase**

- Evaluation of the study and control group vital signs (intraoperative and postoperative), wound swab (intraoperative and postoperative), and signs and symptoms of surgical wound infection by using tool II (Biophysiological measurements) and apply wound assessment during first dressing by using the third tool (Bates-Jensen Wound Assessment Tool.
- The comparison was done between both groups to determine the effect of preoperative and intraoperative nursing intervention on the prevention of surgical site infection among surgical patients.

Statistical Analysis:-

Data were entered and analyzed by using SPSS (Statistical Package for Social Science) statistical package version 22. Graphics were done using Excel program.

Two types of statistics were done:

1) Descriptive statistics:

Quantitative data were presented by mean (X) and standard deviation (SD). It was analyzed using paired t- test for comparison between control group and study group. However, Repeated Friedman Test (type of Chi square test for repeated procedures for qualitative data) was used for comparison between the two time points of intervention in patients participating in the study.

2) Analytic statistics:

1. Pearson Chi-square test ($\chi 2$): It is the test of significance used to study association between two qualitative variables.
2. Fisher`s Exact Test: It is the test of significance used to study association between two qualitative variables when the expected value of any cell in the table was less than 5.
3. Student ttest (paired test): is a test of significance used for comparison between two independent groups of normally distributed quantitative variables.
4. Likelihood Ratio (LR) test: It is the test of significance used to study the association between two qualitative variables when the expected value of any cell in the table was more than 5 .

Results

Table (1) This table shows that Mean ± SD of age in the study and control groups were 42.4±2.3 and 41.9±3.7 years respectively. Among the study group, two thirds of the sample were females (65.5%), while among the control group, about three-quarters of the sample were females (74.5%). Concerning marital status, approximately all subjects of both the study and control groups (96.4% and 98.2%) respectively were married. As regards educational level, about half of the study group had secondary education (43.6%), while among the control group more than one third of the sample had secondary education (36.4%). Regarding residence more than half (54.5%) of both the study and control group came from a rural area. Regarding occupation, more than half of both the study group and the control group (50.9% and 52.7%) respectively were housewives. There were insignificant differences between study and control groups regarding all sociodemographic characteristics (P>0.05 for each .(

Table 2 This table demonstrates that 80% and 81.8% of the study and control group respectively had no previous surgeries. Regarding chronic diseases, the existent study found that the majority of the study and control group had no chronic disease (92.7% and 94.6%) respectively, and hypertension disease was the only chronic disease amongst the control and study group. Regarding the type of surgery, the present study found that 18.2 of the study and control group had thyroidectomy surgery. Regarding the duration before surgery, the present study found that more than half of the study and control groups (63.6% and 60%) respectively had a meeting one week before surgery. There were no significant differences between study and control groups regarding all items of medical data (P>0.05 for each .(

Table 3 This table reveals that 3.6% VR 9.0% of both the study and control group had surgical wound infection respectively. In addition, types of microorganisms gram positive (+ve) bacteria in both study and control group was 50% VR 80 % respectively. There were no significant differences between study and control groups regarding intraoperative wound swab (P>0.05 for each .(

Table 4 This table reveals that among the study group 10.9% of the sample had surgical wound infection, and among the control group more than one third of the sample had surgical wound infection (36.4%). There was a highly significant difference between study and control groups regarding postoperative wound swabs (P<0.002 .(

Table (5) Reveals that, the majority of the study group (89.1%) had no signs and symptoms of surgical wound infection, compared to two third of the control group (63.4%). There was a

highly significant difference between the study and control group (P<0.001.(

Table(6)This table shows that, the majority of the study and control group had normal body temperature (92.7% and 85.5%) respectively, and all patients had normal pulse and blood pressure. Regarding respiration majority of the study and control group (89.1% and 87.3%) respectively were intubated and connected to mechanical ventilation. Regarding oxygen level all patients were in normal range 100% O2 saturation. Each item of intraoperative vital signs and oxygen level wasn't different statistically between the study and control groups (P>0.05 for each)

Table (7) This table shows that, the majority of the study and control groups (92.7% and 83.6%) respectively had normal blood glucose level. There was no statistically different between the study and control groups (P>0.05).

Table (8) This table shows that , the majority of the study group (89.1%) had normal body temperature, pulse, and respiration and about two thirds of the control group (63.6%) had normal body temperature, pulse, and respiration. Regarding blood pressure the majority of the study and control patients had normal blood pressure (92.7% and 94.5%) respectively. There were a highly statistically difference in the vital signs items among the study group and control group (P<0.0008 for each). While blood pressure there wasn't significance differences between study and control group (P <0.19.

Tables (9) this table shows that the majority of the study group had healthy tissue (89.1%) compared to about two thirds among the control group (63.6%) had healthy tissue. Regarding wound severity, two thirds (66.7%) in the study group and half (50%) of the control group had minimal severity. In addition, the mean total wound assessment score was lower in the study group than the control group. There were a highly statistically significant difference between study and control groups regarding all items of Bates-Jensen Wound Assessment Tool(P<0.0001).

Results

Table (1) : Distribution of the studied groups according to their Socio-demographic characteristics.

Socio-demographic characteristics		Studied groups				Test of sig.	P value
		Study group (n=55)		Control group (n=55)			
		NO.	%	NO.	%		
Age (years)	30–39	19	34.5	16	29.1	X^2=0.41	P=0.81 NS
	40 -49	21	38.2	22	40		
	50-59	15	27.3	17	30.9		
Mean ± SD		42.4±2.3		41.9±3.7		T=0.72	P=0.19 NS
Gender	Females	36	65.5	41	74.5	X^2=1.1	P=0. 3 NS
	Males	19	34.5	14	25.5		
Marital status	Married	53	96.4	54	98.2	LR=0.16	P=0.68 NS
	Single	1	1.8	1	1.8		
	Widow	1	1.8	0	0		
Educational level	Illiterate.	4	7.3	2	3.6	LR=1.6	P=0.64 NS
	Basic education	13	23.6	16	29.1		
	Secondary education.	24	43.6	20	36.4		
	University education.	14	25.5	17	30.9		
Residence	Rural	30	54.5	30	54.5	**NA**	**NA**
	Urban	25	45.5	25	45.5		
Occupation	Work	27	49.1	26	47.3	X^2=0.04	P=0.84 NS
	House wife	28	50.9	29	52.7		
Smoking	Yes	9	16.4	8	14.5	X^2=0.07	P=0.79 NS
	No	46	83.6	47	85.5		
If yes, No. Of smoking times / day	Three	3	33.3	2	25	**LR=0.49**	P=0.78 NS
	Four	2	22.2	3	37.5		
	Five	4	44.4	3	37.5		
No. Of smoking cigarette at a time	One	5	55.6	1	12.5	LR=4.6	P=0.09 NS
	Two	4	44.4	6	75		
	Three	0	0	1	12.5		
Duration of smoking (years)	Mean± SD	20 ±5.1		19 ±7.3		t=0.33	0.74 NS
Total		**55**	**100**	**55**	**100**		

NS = Not significant, **NA** = Not Applicable, X^2= Chi Square test., **LR**= Like hood Ratio

Table 2: Distribution of the studied groups according to their medical data.

medical data		Studied groups				Test of sig.	P value
		Study group (n=55)		Control group (n=55)			
Past surgeries	Yes	11	20	10	18.2	X2=0.06	P= 0.81NS
	No	44	80	45	81.8		
Type of past surgery		(No.= 11)		(No.=10)			
	Cesarean Section	7	63.6	8	80	LR=4.5	P= 0.34NS
	Mastectomy	1	9.1	0	0		
	Inguinal hernia	1	9.1	2	20		
	Cholecystectomy	1	9.1	0	0		
	Tonsillectomy	1	9.1	0	0		
Complications from the past surgery	Infection	5	54.4	4	40	LR=0.21	P= 0.64NS
	Bleeding	2	18.1	2	20		
	No	4	36.4	4	40		
Chronic disease	Hypertension	4	7.3	3	5.4	Fisher exact test	P= 0.45NS
	No	51	92.7	52	94.6		
Follow certain diet	Yes	4	7.3	3	27.3	Fisher exact test	P= 0.19 NS
	No	51	92.7	52	72.7		
		(No.= 4)		(No.=3)			
If yes, why	Hypertension	4	100	3	100	NS	NS
Type of diet	No salt and fat	4	100	3	100	NS	NS
Type of present Surgery	Umbilical Hernia	4	7.3	3	5.5	LR=0.03	P=0.85 NS
	Inguinal Hernia	4	7.3	5	9.1		
	Stomach Cancer	4	7.3	3	5.5		
	Esophagus Cancer	2	3.6	2	3.6		
	Mastectomy	7	12.7	10	18.2		
	Hysterectomy	4	7.3	6	10.9		
	Thyroidectomy	10	18.2	10	18.2		
	Nephrectomy	5	9.1	3	5.5		
	Cholecystectomy	2	3.6	2	3.6		
	Intestinal Obstruction	8	14.5	8	14.5		
	Lymph node biopsy underarm	3	5.5	1	1.8		
	Valval mass	2	3.6	2	3.6		
Duration before surgery	One week	35	63.6	33	60	X^2 =3.3	P= 0.07 NS
	Two weeks	20	36.3	22	40		
Total		55	100	55	100		

NA: Not applicable, NS= Not sig. , LR= Likelihood Ratio, X^2 = Chi-square test.

Table 3: Distribution of the studied groups according to their intraoperative surgical wound swab before the closure of the wound.

Intraoperative wound swabs		Studied groups				P value
		Study group (n=55)		Control group (n=55)		
		No.	%	No.	%	
Wound infection	**Absent**	53	96.4	50	90.9	Fissure exact test P=0.44 NS.
	Present	2	3.6	5	9.0	
Types of microorganisms	**Gram+ve bacteria**	1	50	4	80	Fissure exact test P=1.0 NS
	Gram-ve bacteria	1	50	1	20	
Total		55	100	55	100	

Table 4: Distribution of the studied groups according to their post-operative surgical wound swab during first dressings.

Postoperative wound swabs		Studied groups				P value
		Study group (n=55)		Control group (n=55)		
		No.	%	No.	%	
Wound infection	Absent	49	89.1	35	63.6	X2=9.9 P<0.002 HS
	Present	6	10.9	20	36.4	
Types of Microorganisms	Gram+ve bacteria	5	83.3	18	90	Fissure exact test P=1.0 NS
	Gram-ve bacteria	1	16.7	2	10	
Total		55	100	55	100	

Table 5: Distribution of the studied groups according to wound site description (signs and symptoms of surgical wound infection).

Wound site description (signs and symptoms of surgical wound infection)	Studied groups				P value
	Study Group (n=55)		Control Group (n=55)		
	No.	%	No.	%	
Absent	49	89.1	35	63.6	X2=9.8 P<0.001 HS
Present	6	10.9	20	36.4	
Total	55	100	55	100	

Table 6: Distribution of the studied groups according to their preoperative blood glucose level.

Preoperative blood glucose level.		Study group(n=55)		Control group(n=55)		Test of sig.	P value
Blood glucose level	70-100 (Mg/dl)	51	92.7	46	83.6	X^2=1.4	P=0.24 NS
	100-110 (Mg/dl)	4	7.3	9	16.4		
Total		55	100	55	100		

Table 7: Distribution of the studied groups according to their intraoperative vital signs.

Intraoperative vital signs.		Study group(n=55)		Control group(n=55)		Test of sig.	P value
Temperature	36-36.3C	4	7.3	8	14.5	X^2=0.83	P=0.36 NS
	36.4-37.4C	51	92.7	47	85.5		
Pulse	60-100b/m	55	100	55	100	NA	NA
Respiration	Ventlator	49	89.1	48	87.3	X^2=0.09	P=0.77 NS
	12-24 c/m	6	10.9	7	12.7		
BPS	(100-110) mm/Hg	4	7.3	8	14.5	X^2=0.83	P=0.36 NS
	(111-120) mm/Hg	51	92.7	47	85.5		
BPD	(60-70) mm/Hg	4	7.3	8	14.5	X^2=0.83	P=0.36 NS
	(71-80) mm/Hg	51	92.7	47	85.5		
O2 level	Mean ± SD	98.5 ± 1.5		97.5 ± 1.4		t=0.59	P = 0.55 NS
Total		55	100	55	100		

Table 9: Distribution of the studied groups according to Bates-Jensen Wound Assessment Tool during the first dressing.

Wound assessment		Study group(n=55)		Control group (n=55)		Statistical test	P value
		No.	%	No.	%		
Size	1 =Length x width < 4 sq cm	15	27.3	15	27.3	X^2 =0.0	P=1.0 NS
	2 =Length x width 4-<16 sq cm	40	72.7	40	72.7		
Depth	0 = intact skin with no erythema	49	89.1	35	63.6	X^2= 11.2	P<0.0001 HS
	1= intact skin with erythema	6	10.9	20	36.4		
Edges	0 = intact closed wound	55	100	55	100	NA*	NA
Exudate type	1 =None	49	89.1	35	63.3	X^2 = 12.6	<0.0004 HS
	2 =Bloody	1	1.8	6	10.9		
	3 =Serosanguineous: thin, watery, pale red/pink	5	9.1	14	25.5		
Exudate amount	1 = None, dry wound	49	89.1	35	63.3	LR=11.7	< 0.0006 HS
	2 = Scant, wound moist	4	9.1	10	18.2		
	3 = Small	2	1.8	6	10.9		
	4 = Moderate	0	0	4	5.5		
Skin color surrounding wound	1 =Pink or normal	49	89.1	35	63.3	X^2= 11.2	P<0.0001 HS
	2 = redness &/ blanches to touch	6	10.9	20	36.4		
Peripheral tissue edema	1 =No swelling or edema	49	89.1	35	63.3	LR=10.7	<0.001 HS
	2 =Non-pitting edema extends <4 cm around the wound	4	7.3	10	18.2		
	3 =Non-pitting edema extends >4 cm around the wound	2	3.6	10	18.2		
Peripheral Tissue Induration	1 = None present	49	96.4	35	63.3	LR=10.7	<0.001 HS
	2 =Induration < 2 cm around the wound	4	7.3	10	18.2		
	3 =Induration 2-4 cm extending < 50% around the wound	2	3.6	10	18.2		
wound status	Healthy tissue	49	89.1	35	63.6	X^2= 11.2	P<0.0001 HS
	Wound regeneration	6	10.9	20	36.4		
	Wound degeneration	0	0	0	0		
wound severity	Minimal severity	4	66.7	10	50	LR=9.4	P<0.006 S
	Mild severity	2	33.3	10	50		
	Moderate severity	0	0	0	0		
	Extreme severity	0	0	0	0		
Total wound assessment score (Mean ± SD)		11.2 ± 1.5		14.7± 2.1		t=3.7	P<0.0001
Total		55	100	55	100		

NA= Not Applicable, as no statistics were computed because, for edges and sizes the data were constant. LR= Likelihood Ratio (type of X^2). t= Independent sample t-test.

Discussion

Surgical wound infection is defined as an infection related to an operative procedure that occurs at or near the surgical opening. Surgical wound infections can be superficial, deep, or organ/space that includes the anatomy like organs or spaces other than the incision. A patient who had surgical site infection had the following clinical signs of systemic or local infection: including fever, erythema, local warmth, serous exudate, discoloration of granulation tissue, tenderness, localized swelling, purulent drainage, and positive bacterial cultures. (Berríos-Torres et al., 2017 and Haesler, 2019).

Regarding biophysiological measurements: intraoperative wound swab, the current study found that there was no statistically significant difference between the study and control groups regarding intraoperative wound swab. This is consistent with Shirley et al., (2017) who reported that no statistically significant difference between the study and control group. And Mohamed, (2021) who reported that both the study and control group were similar regarding intraoperative wound swab and there was no statistically significant difference. From the researcher's opinion, because there are a few numbers of bacteria in the wound that have not yet multiplied and colonized.

Regarding vital signs, intraoperative vital signs, the existing study found that there was no statistically significant alteration between study and control groups. This is in line with Shirley et al., (2017) and Mohamed (2021) who exists that there was no statistically significant alteration in vital signs amongst both groups. From the researcher's opinion, through the operation, the patient's vital signs become a major concern of the anesthesiologist and all medical staff so there were no differences, and the anesthesiologist given warm fluids to all patients.

Regarding oxygenation, the existing study found that there was no statistically significant change between study and control groups regarding oxygenation. This is consistent with Mohamed (2021) who reported that both the study and the control group were similar regarding intraoperative oxygenation and there was no statistically significant difference. From the researcher's point of view, during the operation, the patient's oxygenation becomes a major concern of the anesthesiologists especially with the patient for general anesthesia.

Regarding preoperative blood glucose level, the existing study revealed that the majority of the study and control groups had normal blood glucose level. This is in line with Showen et al., (2017) who stated that about all of the studied groups had normal blood glucose level. From the researcher's point of view, all patients have an explanation about surgery from the doctor and all patients have relatives which decreases patient stress and reduces stress hyperglycemia. And the researcher apply stress reduction measures for the study group through discussing the patient's fears about surgical procedures, hearing favourite music, relaxation techniques, and reading the holy quran.

Regarding postoperative wound swab, the existing study found that there was a high statistically significant variance between the study and control groups about postoperative wound swab, this result was in line with Uchino et al., (2019)who reported that there was a significant alteration amongst the study and control groups regarding postoperative wound swab. And also Olowo-okere et al., (2018) who stated that the result of the study

presented a high rate of SSIs. In contrast, Abdellah, (2018) revealed that afew rate of the studied group have surgical site infection. And Sprowson et al., (2018) stated that no statistically significant alteration between the study and control group respectively. From the researcher's opinion, these alterations due to preoperative and intraoperative nursing intervention to prevent SSI, the technique of application intervention.

Regarding type of micro-organism the existing study found that the most frequent microorganisms were Gram-positive bacteria between the study and control group, this result was in line with Mohamed, 2021 reported that the result of the study revealed a high incidence rate of SSIs, and the most frequently isolated microorganisms were Gram-positive bacteria. In contrast, Abdellah, (2018) revealed that the greatest microorganism of the study and control group were gram-negative bacteria. From the researcher point of view, gram-positive microorganism was the main normal skin flora but become pathogenic due to bad preoperative skin hygiene for the control group.

Postoperative vital signs before the first dressing the existing study found that there was a high statistically significant alteration amongst study and control groups (P<0.0008 for each).this result was in line with Olowo-okere et al., (2018) and Mohamed, A. (2021) reported that a significant difference between study and control groups in postoperative vital signs. Conversely, Sprowson et al., (2018) reported that no statistically significant alteration amongst study and control group. These alterations were due to infection causing an elevation in temperature, pulse, and respiration.

Regarding wound site description (signs and symptoms of SSI), the existing study found that there was a highly statistically significant alteration between the study and control groups (P<0.0001). It was noticed from the present study groups that most of the infected patients complained of hotness, redness, tenderness, and pain at the site of wound due to infection, these results coincided with the study of Olowo-okere et al., (2018) and Mohamed, 2021 reported that the infected wounds were redness, hotness, swelling, and tenderness.

Regarding Bates-Jensen Wound Assessment tool during the first dressing, the existing study found that the majority of the study group had healthy tissue compared to about two third of the control group had healthy tissue. this result was in line with Guan, et al., (2021) who reported that a significant correlation between positive microbial culture and geography of the wound was observed due to wound infection, and significantly changed between study and control groups due to surgical site infections. And Hassan and Mohammed, (2018) reported that Bates wound assessment scores were lower in study group than control group in the 4th day of intervention in relation to depth, exudate type, exudate amount, and prepherial tissue induration.

Conclusions

Based on the findings of this study, it can be concluded that:

Preoperative and intraoperative nursing interventions have a highly significant effect on the prevention of surgical wound infection among the study group compared to control group. This study proved that using of the preoperative nursing intervention as nutritional support, body shower with chlorohixidine 4%, and hair shaving technique, and intraoperative nursing intervention as wound irrigation,

antimicrobial sutures, and normothermia measures decrease surgical wound infection, and significantly improve wound healing process among the study group compared to control group. Patients who receive the pre-operative and intra-operative nursing intervention (study group) had decreased surgical wound infection rates than patients who don't receive (control group).

Recommendations

Based on the findings of the present study, the following recommendations are derived and suggested:

A. Recommendations for patients:

- self-care strategy should be developed and be available for each patient with surgical procedures to increase patient knowledge, decrease patient stress, improve patient coping skills and develop a positive patient attitude toward self-management which in turn improve functional status.
- Simplified booklet in preoperative preparation should be made available for patients and their families
- all health care instructions regarding preoperative care as skin preparation and nutritional recommendations should be followed by patients

B. Recommendations for nurses

- Simplified booklet should be designed for intraoperative preparation by nurses
- Nurses should follow all preoperative and intraoperative instructions for prevention of SSI.

C. Recommendations for further researches:

- The study should be replicated on larger samples to validate and generalize the findings.
- The study should be replicated at different surgical departments.

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