Effect of Active Cycle Breathing Technique on Postoperative Pain and Respiratory Health Outcomes of Patients undergoing Major Abdominal Surgeries

Hend Ahmed Hussein Biomy, **Student of PhD**
Medical Surgical Nursing Department, Faculty of Nursing, Alexandria University

Mervat Abdel Fattah Mohamed, Professor
Medical Surgical Nursing Department, Faculty of Nursing, University of Alexandria

Heba Abdel Mowla Ahmed Shaaban, Professor
Medical Surgical Nursing Department, Faculty of Nursing, University of Alexandria

Eshrak Salama Hashem, Assistant professor
Medical Surgical Nursing Department, Faculty of Nursing, University of Alexandria

Abstract

Background: *There is a significant chance of both postoperative mortality and complication rate with major abdominal surgery. Various interventions are available that aim to lower the possibility of pulmonary problems following surgery, reduce postoperative pain. One of these interventions is the breathing method known as the active cycle (ACBT).* ***Objective:*** *To determine the impact of implementing an active cycle breathing technique on postoperative pain of and on respiratory health outcomes of patients undergoing major abdominal surgeries.* ***Settings:*** *The study was carried out at the Gastrointestinal, Hepatobiliary, and Pancreatic Surgery Units, at Alexandria Main University Hospital.* ***Subjects:*** *A convenience sample of 80 adult patients, who were divided into two equal groups (study and control group) were recruited for the study.* ***Tools:*** *four tools were used. Tool I: Patients' socio-demographic and clinical data structured interview schedule, Tool II: Pain visual analogue rating scale, Tool III: Postoperative respiratory health outcomes assessment sheet, and Tool IV: Active cycle breathing technique educational session' intervention effectiveness evaluation tool.* ***Results:*** *The ACBT sessions had a potent effect on pain severity with an effect size of (0.989). In addition, there is a large effect of the ACBT on the study group patient's respiratory outcomes (0.975).* ***Conclusion:*** *Active cycle breathing technique application for the study group patients proved to have appositive effect in relation to patient's respiratory outcomes and there were statistically meaningful variations were found between the study group before and after ACBT overall sessions except in the 8th session regarding pain.* ***Recommendations:*** *Establishing regular ongoing educational programs and workshops for updating of nurses knowledge regarding the active cycle breathing technique as air way clearance technique. Furthermore, for pain assessment and management and the developed illustrated booklet should be available and distributed in both Arabic and English language in all surgical units.*

Keywords: Active cycle breathing technique, Postoperative pain, Respiratory health outcomes, Major abdominal surgeries.
Received 30 July 2024; Accepted 14 August 2024; Published March 2025

Introduction

Major abdominal surgery has significant physiologic stressors, including; increasing metabolism and catabolism, increasing oxygen uptake, stress hormone production, and release of inflammatory cytokines. In addition, patients with a low cardiorespiratory reserve cannot meet the increase in postoperative oxygen demand (Gillis, *et al*., 2022; Howard, *et al*., 2019; Fernandes, *et al*., 2019).

Consequently, patients who have an increased rate of postoperative complications are associated with increased mortality, morbidity, and poor overall outcomes. Complications after major abdominal surgery have a detrimental impact on length of stay, resource use, and health-related quality of life (Howard, *et al*., 2019; Fowler, *et al*., 2022; Downe, *et al*., 2023; Haidar, *et al*., 2023; Tazreean, *et al*., 2022).

Approximately 20% of patients have excruciating pain during the first 24 hours following surgery (Small, & Laycock, 2020; Ishida, *et al*., 2022; Gadalla, *et al*., 2021). Patients who receive insufficient pain management suffer consequences, thus it is important to provide them with the suitable form of pain therapy. The Journal of the American Medical Association (JAMA) Network reports that 88% of patients who have surgery experience moderate, severe, or extreme pain levels, accounting for almost more than 80% of postoperative pain reports (Sandhu, *et al*., 2021; Suner, *et al*., 2019).

Postoperative pulmonary problems are a serious health issue; result in 3–12 million fatalities annually. A high percentage of problems occur in about 15% of people undergoing major surgery. The World Health Organization (WHO), 2020 reports that one of the main causes of patient death is PPCs. Postoperative pulmonary problems occur in five–ten% of patients having non-thoracic surgery and 22% of people who are at high risk (World Health Organization, 2020; Tuna, & Akgün, 2023; Morris, *et al*., 2019).

Various interventions are available that aims to lower the possibility of pulmonary problems following surgery, reduce postoperative pain, and improve the overall outcomes in the surgical population (Odor, *et al*., 2020). Active cycle breathing technique (ACBT) is one of these strategies. It consists of three ventilatory stages that are performed in cycles: breathing control, thoracic expansion exercises, and forced expiratory technique. It has been demonstrated that ACBT is useful for improving lung function by mobilizing and eliminating excess bronchial secretions (Allam, *et al*., 2023; Athawale, *et al*., 2021).

Breathing control was the first step. Breathing from the nose was done slowly at this point. In the event that breathing by the nose was not feasible, breathing was accomplished via the mouth. It is recommended to execute this using the "lips of the bud" (Derakhtanjani, *et al*., 2019).

Thoracic expansion, or stretching the chest wall to allow airflow in narrow airways, is the second stage. At this point, the chest wall is enlarged because to the deep, steady, and slow flow of air into the lungs through the nose. The air is retained for two or three seconds before gradually releasing via the mouth. This process was carried out three times (Derakhtanjani, *et al*., 2019).

The third stage involves forced expiratory technique, sometimes known as huffing, which is a maneuver used to drive secretions downstream towards the mouth after they have been mobilized by deep breathing and thoracic expansion exercises (Allam, *et al*., 2023; Phillips, *et al*., 2023; Athawale, *et al*., 2021; Physiopedia, 2021).

The recovery of patients following surgery requires the application of coordinated multidisciplinary care guidelines in collaboration with other medical specialists. Effective care can only be provided when multidisciplinary teams work together to promote and care for patients undergoing major abdominal surgeries (Udomkhwamsuk, *et al*., 2021; Blitz, 2023).

Aims of the Study

This study aimed to determine the effect of implementing an active cycle breathing technique on postoperative pain, and respiratory health outcomes of patients undergoing major abdominal surgeries.

Research hypotheses

- Patients undergoing major abdominal surgeries who receive the proposed an

active cycle breathing technique exhibit less postoperative pain than those who received only the routine hospital nursing care.

- Patients undergoing major abdominal surgeries who receive the proposed active cycle breathing technique exhibit improvement in the postoperative respiratory health outcomes than those who received only the routine hospital nursing care.

Materials and Method

Materials

Design: A quasi-experimental, research design was used to accomplish the aims of the study.

Settings: The present study was carried out at the inpatient Gastrointestinal, Hepatobiliary, and Pancreatic Surgery Units, at Hospital at Alexandria Main University, Egypt.

Subjects: The participants of this study consisted of 80 adult male and female patients, undergoing major abdominal surgeries admitted to the above-mentioned settings.

Inclusion criteria: Adult aged 18 less than 60 years old, non-smokers, communicated effectively, and had adequate cognitive state, free from all the following associating illnesses: increased intracranial pressure, uncontrolled hypertension, cardiac, pulmonary, and/or musculoskeletal disorders and accepted to participate in the study.

Tools: Four tools were used to gather the data required for the study:

Tool one: "Patients' Socio-demographic and Clinical Data Structured Interview Schedule". This tool was developed by the researcher in English language based on reviewing the relevant recent literature [Allam, *et al*., 2023, Derakhtanjani, *et al*., 2019]. **It included two parts:**

Part I: Patients' socio-demographic characteristics: This part was obtained from patient's interview. It included data regarding the patient's age, gender, marital status, level of education, occupation, and place of residence.

Part II: Patients' clinical data: This part included information related to patient's past, present medical surgical history, previous hospitalization, the length of hospitalization, and family past history. Also, the surgical diagnosis, name of surgery, type of anesthesia, and duration of surgery. Data were obtained from the patient's medical records and interview.

Tool two: Pain Visual Analogue Rating Scale (VAS). This scale was adopted by the researcher from Bjelkaroy, *et al*., 2024 to assess the pain intensity as a baseline data for both studied groups (study and control). The range is represented by a line, usually 10 cm in length with or without marks at each centimeter. The patient will select the number from (0-10) that reflects the intensity of pain.

Tool three: Postoperative Respiratory Health Outcomes Assessment Sheet. This tool included two parts:

Part I: Nursing outcomes classification (NOC) indicators of Respiratory Status by the level of severity: This tool was adapted by the researcher in English language from Barreto, *et al*., 2020; Araujo Almeida, *et al*., 2017. To assess the postoperative respiratory health outcomes. It included an assessment of 17 NOC indicators belonging to the respiratory status outcomes.

Part II: Postoperative respiratory outcomes diagnostic criteria: This tool was adapted by the researcher from the Melbourne group score [Wang, *et al*., 2023; Boden, *et al*., 2018]. The Melbourne letters reflect a group contribution.

Tool four: Active Cycle Breathing Technique Educational Sessions' Intervention Effectiveness evaluation Tool. This tool was developed by the researcher in English language based on reviewing

the recent relevant literature (Shackman, 2018; Atta, 2023) to evaluate the ACBT educational session' effectiveness from the studied group participants' point of view. It included eight items related to the technique objectives, application, time, duration, frequency, audiovisual aids, teaching environment and effect of the technique on postoperative pain, and respiratory health.

Method

The faculty of nursing's ethical committee gave its approval. An official approval to conduct this study was obtained after providing explanation of the aim of the study. An informed consent was obtained from the patients. Five experts in the field of the study evaluated the content validity of the study tools. The necessary modifications were done accordingly. To ensure that the research tools were applicable and clear, a pilot study involving 10% of the study population was conducted. The Cronbach's Alpha test was used for evaluating the tools' reliability. The reliability coefficient values were 0.850 for tool two, 0.813 for tool three (part I), and 0.777 for tool three (part II) and 0.997 for tool four which is acceptable. Data was collected over 8 months from the beginning of August 2021 to the beginning of April 2022.

To avoid a potential double contamination effect between the studied groups that could have an impact on the study outcomes, data were initially obtained from the control group and then, after the study group was finished.

The study was carried out in four phases:
Phase I: Assessment for patients in both groups: Socio-demographic and clinical data were obtained in this phase using tool I to collect the necessary baseline data.

Phase II: Planning phase: Active cycle breathing technique was designed by the researcher after reviewed recent relevant literature (Allam, et al., 2023; Athawale, et al., 2021; Physiopedia, 2021; Zuriati, et al., 2020). Illustrated booklet and video presentation were developed by the researcher and handled individually to every patient in the study group for more illustration of the active cycle breathing techniques.

Phase III: Implementing the active cycle breathing technique. For study group: Two sessions, of ACBT were carried out daily for four consecutive days preoperatively. In each session, the ACBT was performed five times. Each ACBT cycle take about two minutes, with one minute of rest, between cycles. This exercise was done by patients in the presence of the researcher 6 hours after surgery**.** Subjects of the study carried out ACBT twice daily, 5 times per session for 5 consecutive days, postoperatively.
The active cycle breathing technique was carried out through three phases as follows:
1st phase breathing control.
2nd phase chest expansion exercises.
3rd phase huffing, or huff coughing.

Phase IV: Program evaluation was carried out daily for 5 consecutive days postoperatively, to assess the presence of postoperative pain and identify any indicator of postoperative respiratory complications (tool II and tool III).

Ethical considerations:

An informed consent was obtained from patient following a description of the study's objectives and the participant's choice to reject participation in the study and/or withdraw at any moment. Patient's privacy was respected. Data confidentiality was maintained while the study was being conducted.

Statistical Analysis

The statistical software for social studies (SPSS) Version 25.0 was utilized to arrange, tabulate, and perform statistical analysis on the gathered data. The following statistical

analysis measures were used; descriptive statistical measures, such as numbers, percentages and averages. For this research, a P equal to or less than 0.05 was chosen as the significance level.

Results

Table 1 shows comparison between the study and control group patients according to their pain level before and after the ACBT sessions' intervention. There was statistically significant variations are detected between the study and control group post-ACBT sessions for the study group throughout all the ACBT sessions except in the 7th, 8th, and 9th sessions (P= 0.000), and also, there was significant differences are found between the study group before and after intervention in all sessions except in the 8th session (P= 0.000).

Table 2 reveals comparison between the study and control groups patients according to the respiratory outcomes levels according to nursing outcome classification before and after the session's intervention. In relation to NOC, there is a large effect (0.975) of the ACBT on the study group patient's respiratory outcomes.

Table 3 reveals comparison between the study and control group patients according to the presence of postoperative diagnostic criteria. Significant statistical differences were detected between the experimental and control group patients in the third, fourth, and fifth assessment days with (P= 0.000). On the fourth and fifth assessment days, the majority (97.55, 75%, 100%, and 75%) of patients respectively among both groups had not respiratory complications, while the minority of the control group (25%, and 25%) had respiratory complications.

Discussion

One of the most painful surgeries is major abdominal surgery, which also has a negative impact on respiratory function after the surgery (Kumar, 2019). Postoperative complications (POCs) after abdominal surgery have significant concerns to health care providers due to their potential for death or chronic infirmity. It negatively impacts numerous important facets of patients' health (Dajenah, *et al*., 2022).

The main results of the present study showed that performing of the ACBT for postoperative patients resulted in improvements in postoperative pain and respiratory health outcome. These results are reinforced by multiple studies, as Derakhtanjani *et al*., (2019), Karagoza *et al., (2023)***,** Allam *et al., (2023) and* Araujo Almeida, *et al., (2017)* evaluated the impact of the ACBT on postoperative pain and respiratory status in postoperative of abdominal surgeries patients.

Similarly, Ju, *et al*., (2019) carried out a systematic review and meta-analysis of relaxation therapy as an effective nursing intervention for reducing pain after surgery in patients having abdominal surgery. They illustrated that performing of breathing control as a first phase of active cycle breathing technique which promotes feeling of comfort, relaxation, decrease mental and physical stress, which lowers the hypothalamic sympathetic nervous system. This alters the neural systems' natural synthesis of opioids, which slows the transmission of pain impulses. In addition, Wahyudi *et al*., (2021), who investigate the impact of the active cycle breathing technique on patients who have had heart surgery to clear their airways and reported that after ACBT, the study groups' respiratory rates significantly changed on the 1st and 3rd assessment days.

In relation to dyspnea at exertion, it was observed that from the 5th to 7th session, a minority of patients started to have mild dyspnea at exertion before and after-ACBT session. Then all the study group patients return to have no dyspnea at exertion before, and after-ACBT from the 8th to 11th session.

This might be attributed to practicing the diaphragmatic breathing technique which is

an important part of ACBT. Diaphragmatic breathing technique strengthening the diaphragm, decrease work of breathing which in turn decrease dyspnea. Furthermore, diaphragmatic breathing increases the relaxing of muscles and fosters a comforting sensation; the respiratory muscles also experience this relaxation. Additionally, respiratory muscle relaxation decreases discomfort and relieves stress and anxiety, all of which may have a positive impact on dyspnea (Zisi, *et al*., 2022). This is in the same line of Samuel, (2019) who stated that, ACBT was effective in reducing the level of dyspnea.

Regarding respiratory outcomes according to NOC before and after the session's intervention, there is a large effect of the ACBT on the study group patient's respiratory outcomes. It may be attributed to that an active cycle of breathing techniques had potent impact on health of respiration in the finding of the study. It had demonstrated to be beneficial in improving lung function and mobilizing and removing extra bronchial secretions (Physiopedia, 2021). The findings of this study are consistent with those of Derakhtanjani *et al*., 2019 who reported that it appears that patients undergoing abdominal surgery benefit more from ACBT than those having CABG.

As regards the presence or absence of respiratory complications, the study and control groups patients showed statistically significant differences in the 3rd, 4th, and 5th days of assessment. These findings can be explained by that the ACBT integrates ventilation promotion with airway clearance **(**Allam *et al*., 2023; Belli *et al*., 2021). This is consistent with Zhong, *et al*., 2022 and Wange, *et al*., 2016. They reported that patients who had ACBT demonstrated an effective ability to remove secretions from their own airways, hence minimizing the risk of secretion retention-related postoperative pulmonary problems.

Conclusion

Based upon the results of the current study, it could be found that the active cycle breathing technique application for the study group patients proved to have appositive effect in relation to patient's respiratory outcomes according to nursing outcome classifications, and the presence or absence of respiratory complications postoperative.

Recommendations

Based on the results of the current study, the following ***recommendations*** *had been suggested:*

- Establishing regular ongoing educational programs and workshops for updating of their knowledge regarding the active cycle breathing technique as air way clearance technique. Furthermore, for pain assessment and management .
- Development of policies, procedures standards and manual guidelines for care providers and patients at surgical units and respiratory departments about active cycle breathing technique.
- Study of comparison of active cycle of breathing technique (ACBT) with other methods of airway clearance therapies for patients underwent major abdominal surgery.

Table (1): Comparison between the study and control group patients according to their pain level before and after the ACBT sessions' intervention.

Pain severity/ session		Study group (n=40)				Control group (n=40)				Test of significance
		Before		After		Before		After		
		No.	%	No.	%	No.	%	No.	%	
1st session	Moderate			38	95.0					X^{2a}= NA
	Severe	40	100.0			40	100.0	40	100.0	X^{2b}= 72.38 P= 0.000*
Test of Significance		***X^{2c}= 72.38 P=***				***X^{2d}= NA***				
2nd session	Mild			1	2.5	1	2.5			X^{2a}= 10.91 P= 0.004*
	Moderate	9	22.5	38	95.0					X^{2b}= 76.09 P= 0.000*
	Severe	31	77.5	1	2.5	39	97.5	40	100.0	
Test of Significance		***X^{2c}= 47.02 P=***				***X^{2d}= 0.002 P= 0.987***				
3rd session	Mild			37	92.5					X^{2a}= 5.541 P= 0.019*
	Moderate	37	92.5	2	5.0	29	72.5	40	100.0	X^{2b}= 72.38 P= 0.000*
	Severe	3	7.5	1	2.5	11	27.5			
Test of Significance		***X^{2c}= 69.41 P= 0.000****				***X^{2d}= 12.75 P= 0.000****				
4th session	Mild			27	67.5					X^{2a}= 2.051 P= 0.152
	Moderate	38	95.0	13	32.5	40	100.0	40	100.0	X^{2b}= 40.75 P= 0.000*
	Severe	2	5.0							
Test of Significance		***X^{2c}= 41.25 P= 0.000****				***X^{2d}= NA***				
5th session	Mild			39	97.5					X^{2a}= NA
	Moderate			1	2.5	40	100.0	40	100.0	X^{2b}= 76.09 P= 0.000*
Test of Significance		***X2c= 76.09 P= 0.000****				***X2d= NA***				
6th session	Mild			27	67.5					X^{2a}= 14.12 P= 0.000*
	Moderate	28	70.0	12	30.0	40	100.0	40	100.0	X^{2b}= 43.08 P= 0.000*
	Severe	12	30.0	1	2.5					
Test of Significance		***X2c= 42.71 P= 0.000****				***X2d= NA***				
7th session	Mild			28	70.0			20	50.0	X^{2a}= 12.75 P= 0.000*
	Moderate	29	72.5	12	30.0	40	100.0	20	50.0	X^{2b}= 3.333 P= 0.068
	Severe	11	27.5							
Test of Significance		***X2c= 46.05 P= 0.000****				***X2d= 26.67 P= 0.000****				

X^2= Chi-Square test **X^{2a}** comparison between the study and control group before intervention **X^{2b}** comparison between the study and control group after intervention

X^{2c} comparison in the study group before and after intervention **X^{2d}** comparison in the control group before and after intervention

X^{2e} comparison in the same group across the days * Significant p at ≤0.05 **NA** not applicable

n: Number of studied patients

Effect size 0.0-0.2 Small effect 0.3 -0.7 Medium effect ≥ 0.8 Large effect

Table (1): Comparison between the Study and Control Group Patients According to their Pain Level Before and After the ACBT Sessions' Intervention cont: table (1)

Pain severity/ session	Study group (n=40)				Control group (n=40)				Test of significance
	Before		After		Before		After		
	No.	%	No.	%	No.	%	No.	%	

8th session	Mild			1	2.5					
	Moderate	39	97.5	39	97.5	40	100.0	40	100.0	X^{2a}= 1.013 P= 0.314 X^{2b}= 1.013 P= 0.314
	Severe	1	2.5							
Test of Significance		***X^{2c}= 2.000 P= 0.368***				***X^{2d}= NA***				
9th session	Mild			28	70.0			20	50.0	X^{2a}= NA X^{2b}= 3.333 P= 0.068
	Moderate	40	100.0	12	30.0	40	100.0	20	50.0	
Test of Significance		***X2c= 43.08 P= 0.000****				***X2d= 46.05 P= 0.000****				
10th session	No			36	90.0					X^{2a}= 2.051 P= 0.152 X^{2b}= 68.84 P= 0.000*
	Mild	38	95.0	3	7.5	40	100.0	40	100.0	
	Moderate	2	5.0	1	2.5					
Test of Significance		***X2c= 66.21 P= 0.000****				***X2d= NA***				
11th session	No	26	65.0	35	87.5					X^{2a}= 40.08 P= 0.000* X^{2b}= 62.22 P= 0.000*
	Mild	11	27.5	5	12.5	37	92.5	40	100.0	
	Moderate	3	7.5			3	7.5			
Test of Significance		***X2c= 6.578 P= 0.037****				***X2d= 3.117 P= 0.078***				
Effect size		**0.989**								

Table (2): Comparison between the study and control groups patients according to the respiratory outcomes levels according to nursing outcome classification before and after the session's intervention.

Items		**Study group (n=40)**				**Control group (n=40)**				**Test of Significance**
		Before		**After**		**Before**		**After**		
		No.	**%**	**No.**	**%**	**No.**	**%**	**No.**	**%**	
1st session	No			4	10.0					X^{2a}= NA X^{2b}= 4.211 P= 0.040* X^{2c}= 4.211 P= 0.040* X^{2d}= NA
	Mild	40	100.0	36	90.0	40	100.0	40	100.0	
2nd session	No	1	2.5	8	20.0					X^{2a}= 1.013 P= 0.314 X^{2b}= 8.889 P= 0.003* X^{2c}= 6.135 P= 0.013* X^{2d}= NA
	Mild	39	97.5	32	80.0	40	100.0	40	100.0	
3rd session	No	12	30.0	39	97.5	6	15.0	5	12.5	X^{2a}= 2.581 P= 0.108 X^{2b}= 58.38 P= 0.000* X^{2c}= 39.43 P= 0.000* X^{2d}= 0.105 P= 0.745
	Mild	28	70.0	1	2.5	34	85.0	35	87.5	
4th session	No	40	100.0	40	100.0	32	80.0	40	100.0	X^{2a}= NA X^{2b}= NA X^{2c}= 8.889 P= 0.003* X^{2d}= NA
	Mild					8	20.0			
5th session	No	24	60.0	25	62.5	21	52.5	21	52.5	X^{2a}= 0.457 P= 0.499 X^{2b}= 0.818 P= 0.366 X^{2c}= 0.053 P= 0.818 X^{2d}= NA
	Mild	16	40.0	15	37.5	19	47.5	19	47.5	
6th session	No	1	2.5	14	35.0					X^{2a}= 1.013 P= 0.314 X^{2b}= 16.97 P= 0.000* X^{2c}= 13.87 P= 0.000* X^{2d}= NA
	Mild	39	97.5	26	65.5	40	100.0	40	100.0	
7th session	No	15	37.5	39	97.5					X^{2a}= 18.46 P= 0.000* X^{2b}= 76.09 P= 0.000* X^{2c}= 32.82 P= 0.000* X^{2d}= NA
	Mild	25	62.5	1	2.5	40	100.0	40	100.0	

Items		Study group (n=40)				Control group (n=40)				Test of Significance
		Before		After		Before		After		
		No.	%	No.	%	No.	%	No.	%	
8th session	No	2	5.0	4	10.0					X^{2a}= 2.051 P= 0.152 X^{2b}= 4.211 P= 0.040* X^{2c}= 0.721 P= 0.396 X^{2d}= NA
	Mild	38	95.0	36	90.0	40	100.0	40	100.0	
9th session	No	5	12.5	5	12.5					X^{2a}= 5.333 P= 0.021* X^{2b}= 5.333 P= 0.021* X^{2c}= NA X^{2d}= NA
	Mild	35	87.5	35	87.5	40	100.0	40	100.0	
10th session	No	40	100.0	40	100.0	28	70.0	29	72.5	X^{2a}= 14.12 P= 0.000* X^{2b}= 12.75 P= 0.000* X^{2c}= NA X^{2d}= 0.061 P= 0.805
	Mild					12	30.0	11	27.5	
11th session	No	40	100.0	40	100.0	29	72.5	37	92.5	X^{2a}= 12.75 P= 0.000* X^{2b}= 3.117 P= 0.077 X^{2c}= NA X^{2d}= 5.541 P= 0.019*
	Mild					11	27.5	3	7.5	
Test of Significance		*X^{2e}= 292.73 P= 0.000**		*X^{2e}= 281.67 P= 0.000**		*X^{2e}= 245.03 P= 0.000**		*X^{2e}= 320.48 P= 0.000**		
Effect size		0.975								

Table (3): Comparison between the study and control group patients according to the presence of postoperative diagnostic criteria.

Items		Study group (n=40)		Control group (n=40)		Test of Significance
		No.	%	No.	%	
6 hours	Had no resp. complications	40	100.0	40	100.0	X^2= NA
1st day	Had no resp. complications	40	100.0	40	100.0	X^2= NA
2nd day	Had no resp. complications	40	100.0	40	100.0	X^2= NA
3rd day	Had no resp. complications	39	97.5	32	80.0	X^2= 8.537 P= 0.003*
	Had resp. complications	1	2.5	8	20.0	
4th day	Had no resp. complications	39	97.5	30	75.0	X^2= 49.56 P= 0.000*
	Had resp. complications	1	2.5	10	25.0	
5th day	Had no resp. complications	40	100.0	30	75.0	X^2= 11.428 P= 0.000*
	Had resp. complications			10	25.0	

References

- Allam, Z., Aysha, Z., Mahmoud, O., Mohamed, S., & Weheida, S. (2023). Effect of active cycle breathing technique on airway clearance among patients underwent cardiac surgery. *Tanta Scientific Nursing*

Journal. 29(2), P.P 172-88.

- Araujo Almeida, A., Pascoal, L., Santos, F., Neto, P., Nunes, S., & Sousa, V. (2017). Respiratory status of adult patients in the postoperative period of thoracic or upper abdominal surgeries. *Revista Latino-Americana de Enfermagem*. 25(1), P.P 1-8.

- Athawale, V., Lalwani, L., & Mishra, G. (2021). Comparison of the active cycle of breathing technique (ACBT) versus active cycle of breathing technique with flutter in bronchiectasis. *National Journal of Medical Research.* 10(4), P.P 178-80.

- Atta, L. (2023). Five keys to conducting an effective educational assessment. Available at: https://qorrectassess.com/en/blog/author/leila-atta/. Retrieved on 11-4-2024.

- Barreto, L., Silva, M., Nomura, A., Lucena, A., & Almeida, M. (2020). Clinical evolution of nursing outcome indicators in patients with ineffective breathing pattern. *Revista Eletronica de Enfermagem*. 22(60784), P.P 1-8.

- Belli, S., Prince, I., Savio, G., Paracchini, E., Cattaneo, D., Bianchi, M., ... & Balbi, B. (2021). Airway clearance techniques: the right choice for the right patient. *Frontiers in Medicine*. 8, P.P 1-10.

- Bjelkaroy, M., Benth, J., Simonsen, T., Siddiqui, T., Cheng, S., Kristoffersen, E., & Lundqvist, C. (2024). Measuring pain intensity in older adults. Can the visual analogue scale and the numeric rating scale be used interchangeably?. *Progress in Neuro-psychopharmacology & Biological Psychiatry*. 130, P.P 1-6.

- Blitz, J. (2023). Preoperative evaluation in the 21st century. *Anesthesiology*. 139(1), P.P 91–103.

- Boden, I., Skinner, E., Browning, L., Reeve, J., Anderson, L., Hill, C., et al. (2018). Preoperative physiotherapy for the prevention of respiratory complications after upper abdominal surgery: Pragmatic, double blinded, multicentre randomised controlled trial. *British Medical Journal*. 24(360), P.P 1-14.

- Dajenah, M., Ahmed, F., Thabet , A., Ghaleb, K., & Nikbakht, H. (2022). Early postoperative complications of gastrointestinal surgery and its associated factors in Yemeni patients treated in a teaching hospital: A retrospective monocentric study. *Cureus Journal of Medical Science*. 14(5), P.P 1-10.

- Derakhtanjani, A., Jaberi, A., Haydari, S., & Bonabi, T. (2019). Comparison of the effect of active cyclic breathing technique and routine chest physiotherapy on pain and respiratory parameters after coronary artery graft surgery: A randomized clinical trial. *Anesthesia and Pain Medicine*. 9(5), P.P 1-8.

- Downe, C., Bainbridg, J., Jayne, D., & Mead, D. (2023). Impact of in-hospital postoperative complications on quality of life up to 12 months after major abdominal surgery. *British Journal of Surgery*. 110(9), P.P 1206-12.

- Fernandes, A., Rodrigues, J., Lages, P., Lança, S., Mendes, P., Antunes, L., ... & Santos, L. L. (2019). Root causes and outcomes of postoperative pulmonary complications after abdominal surgery: A retrospective observational cohort study. *Patient Safety in Surgery*. 13(1), P.P 40.

- Fowler, A., Wan, Y. Prowle, J., Chew, M., Campbell, D., Cuthbertson, B., ... & Abbott, T. (2022). Long-term mortality following complications after elective surgery: A secondary analysis of pooled data from two prospective cohort studies. *British Journal of Anaesthesia.* 129(4), P.P 588-97.

- Gadalla, E., Abdelazim, E., & Abdrabo, A. (2021). Updates in postoperative pain management. *Benha Journal of Applied Sciences*. 6(5), P.P 269-74.

- Gillis, C., Ljungqvist, O., & Carli, F. (2022). Prehabilitation, enhanced recovery after surgery, or both? A narrative review. *British Journal of Anaesthesia*. 128(3), P.P 434-48.

- Haidar, S., Vazquez, R., & Medic, G. (2023). Impact of surgical complications on hospital costs and revenues: Retrospective database study of medicare claims. Journal of Comparative Effectiveness Research. 12(7), P.P 2042-6313.

- Howard, R., Yin, Y., McCandless, L., Wang, S., Englesbe, M., & Machado-Aranda, D. (2019). Taking control of your surgery: Impact of a pre-habilitation program on major abdominal surgery. *Journal American College Surgeons*. 228(1), P.P 1-16.

- Ishida, Y., Okada, T., Kobayashi, T., Funatsu, K., & Uchino, H. (2022). Pain management of acute and chronic postoperative pain. *Cureus*. 14(4), e23999.

- Ju, W., Ren, L., Chen, J., & Du, Y. (2019). Efficacy of relaxation therapy as an effective nursing intervention for postoperative pain relief in patients undergoing abdominal surgery: A systematic review and meta-analysis. Experimental and Therapeutic Medicine. 18(4), P.P 2909-16.

- Karagoza, O., & Sayilan, A. (2023). The effection pain and anxiety of a breathing exercise applied following laparoscopic cholecystectomy: A randomized controlled study. *Brain Behavior and Immunity Integrative*. 2, P.P 1-6.

- Kumar, N. (2019). Analgesia in major abdominal surgery. *Anesthesia & Analgesia*. 129(5), P.P 168.

- Morris, K., Weston, K., Davy, A., Silva, S., Goode, V., Pereira, K., ... & Clarke, D. (2022). Identification of risk factors for postoperative pulmonary complications in general surgery patients in a low-middle income country. PLoS One. 17(10), P.P 1-15.

- Odor, P. M., Bampoe, S., Gilhooly, D., & Creagh-Brown, B. (2020). Perioperative interventions for the prevention of postoperative pulmonary complications: Systematic review and meta-analysis. *British Medical Journal*. 368, P.P 1-19.

- Samuel, J. (2019). Immediate effect of the autogenic drainage over the active cycle of breathing technique in airway clearance in subjects with chronic bronchitis a quasi experimental study. *Journal of Clinical and Diagnostic Research*. 13(11), P.P 1-4.

- Sandhu, H., Miller, C., Tanaka, A., Estrera, A., & Charlton-Ouw, K. (2021). Effectiveness of standard local anesthetic bupivacaine and liposomal bupivacaine for postoperative pain control in patients undergoing truncal incisions. *JAMA Network*. 4(3), P.P 1-14.

- Shackman, G. (2018). What is program evaluation? A beginners guide. Available at: https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3060080. Retrieved on 20-5-2023.

- Suner, Z. C., Kalayci, D., Sen, O., Kaya, M., Unver, S., & Oguz, G. (2019). Postoperative analgesia after total abdominal hysterectomy: Is the transverse abdominal plane block effective? *Nigerian Journal of Clinical Practice*. 22(4), P.P 478-84.

- Phillips, J., Hing, W., Pope, R., Canov, A., Harley, N., & Lee, A. (2023). Active cycle of breathing technique versus oscillating PEP therapy versus walking with huffing during an acute exacerbation of bronchiectasis: A randomized, controlled trial protocol. *BMC Pulmonary Medicine Journal.* 23(36), P.P1-12.

- Physiopedia. (2021). Active cycle of breathing technique. Available at: https://www.physiopedia.com/Active_cycle_of_breathing_technique. Retrieved on 1-12-2023.

- Physiopedia. (2021). Chest physiotherapy. Available at: https://www.physiopedia.com/chest_physiotherapy. Retrieved on 1-12-2023.

- Small, C., & Laycock, H. (2020). Acute postoperative pain management. British *Journal of Surgery*. 107(2), P.P 70-80.

- Tazreean, R., Nelson, G., & Twomey, R. (2022). Early mobilization in enhanced recovery after surgery pathways: current evidence and recent advancements. *Journal of Comparative Effectiveness Research*. 11(2), P.P 121-9.

- Tuna, M., & Akgün, M. (2023). Preoperative pulmonary evaluation to prevent postoperative pulmonary complications. *Anesthesiology and Perioperative Science*. 1(34), P.P 1-14.

- Udomkhwamsuk, W., Vuttanon, N., & Limpakan, S. (2021). Situational analysis on the recovery of patients who have undergone major abdominal surgery. *Nursing Open*

Journal. 8, P.P 140-146.

- Wahyudi, D., Xanda, A., Sukesi, N., Puspita, L., Wardani, P., Yurlina, E., ... & Mukhlis, H. (2021). Active cycle of breathing to respiratory rate in patients with lung tuberculosis. *International Journal of Pharmaceutical Research*. 13(1), P.P 4776-84.

- Wange, P., Jiandani, M., & Mehta, A. (2016). Incentive spirometry versus active cycle of breathing technique: Effect on chest expansion and flow rates in post-abdominal surgery patients. *International Journal of Research in Medical Sciences*. 4(11), P.P 4762-6.

- Wang, Y., Luo, Z., Huang, W., Zhang, X., Guo, Y., & Yu, P. (2023). Comparison of tools for postoperative pulmonary complications after cardiac surgery. *Journal of Cardiothoracic and Vascular Anesthesia*. 37(8), P.P 1442-8.

- World Health Organization. (2020). The top ten causes of death. Available at: https://www.who.int/news-room/fact-sheets/detail/the-top-ten-causes-of-death. Retrieved on 10-11-2023.

- Zhong, J., Zhang, S., Li, C., Hu, Y., Wei, W., Liu, L., Wang, M., ... & Su, X. (2022). Active cycle of breathing technique may reduce pulmonary complications after esophagectomy: A randomized clinical trial. *Thoracic Cancer*. 13(1), P.P 76-83.

- Zisi, D., Chryssanthopoulos, C., Nanas, S., & Philippou, A. (2022). The effectiveness of the active cycle of breathing technique in patients with chronic respiratory diseases: A systematic review. *The Journal of Cardiopulmonary and Acute Care*. 53, P.P 89-98.

- Zuriati, Z., Surya, M., & Zahlimar, Z. (2020). Effectiveness active cycle of breathing technique (ACBT) with pursed lips breathing technique (PLBT) to tripod position in increase oxygen saturation in patients with COPD, West Sumatera. *Enfermería Clínica*. 30(5), P.P164-7.