NOVATEUR PUBLICATIONS
JournalNX- A Multidisciplinary Peer Reviewed Journal
ISSN No: 2581 - 4230
VOLUME 6, ISSUE 6, June -2020

APPLIED COLD THERAPY BEFORE DEEP BREATHING AND COUGHING EXERCISE ON ACUTE PAIN INPATIENT WHO UNDERGOING CARDIAC SURGERY

IKA AINUR ROFI'AH
Specialist Program Medical-Surgical Nursing Faculty of Nursing University of Indonesia, STIKes Bina Sehat PPNI Mojokerto City, East Java, Indonesia
Email: ns.ikaainur@gmal.com

ELLY NURACHMAH
Faculty of Nursing Universitas of Indonesia, Depok, East Java, Indonesia

MUHAMAD ADAM
Faculty of Nursing Universitas of Indonesia, Depok, East Java, Indonesia

ABSTRACT:
Purpose of the study: The purpose of evidence-based nursing (EBN) to prove the effectiveness of cold therapy before deep breathing and coughing exercises on acute pain in a patient undergoing cardiac surgery.
Methodology: This EBN used a quasi-experimental method. The sample total was 60 respondents (control group was 30 respondents and intervention group was 30 respondents) in patients who underwent cardiac surgery by given gel pack over the surgical wound for 20 minutes and twice for 72 hours postoperative. The test statistic used time series with repeated measure ANOVA and Friedman.
Main Findings: The results of the analysis showed that there was significant differences in the mean pain intensity score and mean pain interference score between the control and intervention group at the 1st, 2nd, and 3rd measurements (p-value=0.001; α<0.05). Cold therapy can be used as an independent nursing intervention for nursing problems in acute pain in post-cardiac surgery patients.
Applications of this study: The application of advanced EBN can be applied to provide cold therapy with a longer duration after cardiac surgery patients who experience pain when deep breathing and coughing effectively.
Novelty/Originality of this study: Pain can be overcome not only pharmacologically but also with non-pharmacology. Cold therapy before breathing deeply and coughing exercises in acute pain in patients undergoing cardiac surgery.

KEYWORDS: cold therapy, sternotomy pain, cardiac surgery

INTRODUCTION:

Cardiac surgery patients experience acute pain due to cardiac surgical incision wounds made during surgery. Sternotomy wounds can cause acute pain, which is an unpleasant sensory and emotional experience due to actual tissue damage (sternotomy wound) which is the most common symptom after cardiac surgery patients. Although the patient has enough knowledge, the patient still reports uncontrolled pain during the acute phase after cardiac surgery. Patients experience pain scores at high levels during the 24-72 hours. This pain is described as pain, sharp, throbbing, stabbing, burning, sore (Herdman et al., 2018; Huang et al., 2016;

Keawnantawat et al., 2018; Zencir & Eser, 2016).

Cardiac surgery is one of the largest surgical operations in the world and increased by about 500% in the US from 1979-2005. At the Harapan Kita Heart and Vascular Hospital, data were obtained based on complaints after cardiac surgery patients (72 hours) in the Intermediate Ward Surgery Room reported moderate to severe pain (90%) when the patient deep breathing and coughing. From the results of the interview all patients, 100% felt uncomfortable and there was a feeling of fear when deep breathing and coughing due to pain felt.

Postoperative pain results in decreased respiratory movements, abdominal and intercostals muscle weakness, inadequate lung expansion and decreased inspiratory capacity and volume due to ineffective coughing. These changes contribute to the development of pulmonary complications postoperative (pneumonia and atelectasis). Analgesic drugs can reduce pain to a certain point, increasing the analgesic dose causes a negative effect (Keawnantawat et al., 2018; Zencir & Eser, 2016).

Non-pharmacological pain management that is usually given to patients with pain complaints includes deep breathing, guided imagery, distraction, or listening to music. However, experience after cardiac surgery is moderate to severe acute pain during deep breathing and coughing. Cold therapy is an effective, inexpensive, and simple intervention for the management of acute pain in postoperative patients (Huang et al., 2016; Keawnantawat et al., 2016).

The mechanism of cold therapy that is changing the speed of nerve conduction (inhibiting nociceptors) can inhibit information that will be transmitted to the cerebral cortex and limbic system so that the perceived pain is reduced or lost. Evidence-based practice was performed to prove the effectiveness of cold therapy before deep breathing and coughing exercises were effective against acute pain after cardiac surgery patients.

METHOD:

The application of evidence-based nursing (EBN) used quasi-experimental methods. The sample was 60 respondents (the control group of 30 respondents and the intervention group of 30 respondents) in patients undergoing cardiac surgery with the following inclusion criteria: 1) age >18 years; 2) good and cooperative awareness; 3) no neurological deficit; 4) can read and write; 5) willing to be a respondent. While the exclusion criteria include: 1) patients undergoing emergency surgery; 2) patients who experience postoperative complications (infection, bleeding, uncontrolled atrial fibrillation, or wound dehiscence).

The intervention was carried out for 3 days (72 hours of the postoperative patient after the extubation patient) 2 times per day with a duration of 20 minutes on a sternotomy wound with a temperature of 10-15^{0}C at 10:00 WIB and 14:00 WIB in the ICU Adult and IW Surgical at the Harapan Kita Heart and Vascular Hospital. The instrument was a modification of the Brief Pain Inventory (BPI) to measure the pain scale. Measurements were made for 3 days three times by asking the patient to deep breathing and coughing effectively for 3 cycles.

RESULT:

The results of univariate analysis based on respondent characteristics, mean of age in the intervention group was 46.53 years with a standard deviation of 15.68 years. The mean of Morphine in 72 hours postoperative in the intervention group was 204.00 mcg/Kg with a standard deviation of 65.46 mcg/Kg. The gender proportion of the intervention group was mostly male at 73.3%, while the gender

proportion in the control group was the same between men and women at 50%.

The proportion of marital status respondents mostly married in the intervention group was 73.33% and the control group was 83.33%. The level of education in the intervention group was Academies/Colleges at 50.00%, Senior High School at 40.00%, Junior High School at 6.67%, and Elementary School at 3.33%. Whereas in the control group of the respondent with a level of education senior high school was 50.00%, Academy/Higher Education at 26.67%, junior high school at 13.34%, Elementary School at 6.67%, and illiterate at 3.33%.

The majority of surgical history was never approved by surgery in the intervention group at 86.67% and the control group at 66.67%. Most of the types of operations CABG, that the intervention group was 53.33% and the control group was 33.33%. The area of postoperative injury was mostly 3 wound areas in the intervention group at 46.67%, while 1 area in the control group was 63.33%.

The results of univariate analysis based on the mean pain score obtained a mean of mean pain intensity of 1st day in the intervention group was 3.97 with a standard deviation of 0.76, while the mean in the control group was 4.88 with a standard deviation of 0.61. The mean of mean pain intensity score of the 2nd day in the intervention group was 2.98 with a standard deviation of 0.59, while the mean in the control group was 4.54 with a standard deviation of 0.62. The median mean pain intensity score on the 3rd day in the intervention group was 2.25 with the lowest mean score of 1.75 and the highest score of 4.00, while the mean in the control group was 4.19 with a standard deviation of 0.57.

Table 1 Characteristics of Respondents in the Intervention and Control Groups at Harapan Kita Heart and Vascular Hospital in March-April 2019 (N = 60)

Variable	Group	Mean	Median	SD	Min-Max	95% CI Lower-Upper
Age	Intervention*	46.53	48.00	15.68	21.00-74.00	40.68-52.39
	Control	49.93	55.00	14.52	19.00-66.00	44.51-55.36
Morphine (mcg/Kg)	Intervention*	204.00	200.00	65.46	40.00-385.00	179.56-228.44
	Control*	245.00	252.50	68.57	115.00-400.00	219.40-270.60

Variable		Intervention (n=18)		Control (n=18)		Total	
		n	%	n	%	n	%
Gender	Male	22	73.33	15	50.00	37	61.67
	Female	8	26.67	15	50.00	23	38.33
	Total	30	100	30	100	60	100
Marital Status	Single	7	23.34	2	6.67	9	15.00
	Married	22	73.33	25	83.33	47	78.33
	Widow/Widower	1	3.33	3	10.00	4	6.67
	Total	30	100	30	100	60	100
Level of Education	Illeterate	0	0	1	3.33	1	1.67
	Elementary School	1	3.33	2	6.67	3	5.00
	Junior High School	2	6.67	4	13.33	6	10.00
	Senior High School	12	40.00	15	50.00	27	45.00
	Academia/College	15	50.00	8	26.67	23	38.33
	Total	30	100	30	100	60	100

History of Surgery	Yes	4	13.33	10	33.33	14	23.33
	No	26	86.67	20	66.67	46	76.67
	Total	30	100	30	100	60	100
Type of Operation	CABG	16	53.33	10	33.33	26	43.33
	Valve (1)[a]	0	0	4	13.33	4	6.67
	Valve (2)[b]	4	13.34	6	20.00	10	16.67
	CABG+Valve	1	3.33	2	6.67	3	5.00
	Aorta	1	3.33	1	3.33	2	3.33
	ASD/VSD Clossure[1]	2	6.67	2	6.67	4	6.67
	Clossure+Valve	5	16.67	4	13.34	9	15
	Others	1	3.33	1	3.33	2	3.33
	Total	30	100	30	100	60	100
Wound area	1 Wound area	13	43.33	19	63.33	32	53.33
	2 Wound area	3	10.0	4	13.34	7	11.67
	3 Wound area	14	46.67	7	23.33	21	35
	Total	30	100	30	100	60	100

* Data is normally distributed

The median mean pain interference score on 1st day in the intervention group was 2.00 with the lowest mean score of 1.67 and the highest 4.00, while the mean in the control group was 2.67 with a standard deviation of 0.40. The median mean pain interference score on 2nd day in the intervention group was 1.67 with the lowest mean score of 1.17 and the highest score of 3.17, while the mean in the control group was 2.37 with a standard deviation of 0.31. The median mean pain interference score on the 3rd day in the intervention group was 1.33 with the lowest mean score of 1.00 and the highest score of 2.50, while the median in the control group was 2.17 with the lowest mean score of 1.67 and the highest score of 3.17.

Table 2 Distribution of Respondents Based on Mean Pain Intensity Scores & Mean Pain Interference Scores in the Intervention and Control Groups at Harapan Kita Heart and Vascular Hospital in March-April 2019 (N = 60)

Mean Score		Group	Mean	Median	SD	Min-Max	95% CI Lower-Upper
Pain Intensity	Day 1	Intervention*	3.97	4.00	0.76	2.75-5.75	3.69-4.26
		Control*	4.88	4.75	0.61	3.75-6.00	4.65-5.11
	Day 2	Intervention*	2.98	2.75	0.59	1.75-2.50	2.76-3.21
		Control*	4.54	4.63	0.62	3.25-5.75	4.31-4.77
	Day 3	Intervention	2.27	2.25	0.49	1.75-4.00	2.09-2.46
		Control*	4.19	4.25	0.57	3.00-5.75	3.98-4.41
Pain Interference	Day 1	Intervention	2.17	2.00	0.51	1.67-4.00	1.97-2.36
		Control*	2.67	2.67	0.40	1.83-3.50	2.52-2.82
	Day 2	Intervention	1.68	1.67	0.39	1.17-3.17	1.53-1.82
		Control*	2.37	2.33	0.31	1.83-3.33	2.25-2.49
	Day 3	Intervention	1.42	1.33	0.27	1.00-2.50	1.32-1.52
		Control	2.20	2.17	0.28	1.67-3.17	2.09-2.30

* Data is normally distributed

Table 3 Distribution of Respondents Based on Differences in Mean Pain Intensity and Mean Pain Interference in the Intervention and Control Groups at Harapan Kita Heart and Vascular Hospital in March-April 2019 (N = 60)

Variable	Group	Mean	Median	Min-Max	p-value
Pain Intensity					
Day 1	Intervention*	3.97	4.00	2.75-5.75	0.001**
	Control*	4.88	4.75	3.75-6.00	
Day 2	Intervention*	2.98	2.75	1.75-2.50	0.001**
	Control*	4.54	4.63	3.25-5.75	
Day 3	Intervention	2.27	2.25	1.75-4.00	0.001**
	Control*	4.19	4.25	3.00-5.75	
Pain Interference					
Day 1	Intervention	2.17	2.00	1.67-4.00	0.001**
	Control*	2.67	2.67	1.83-3.50	
Day 2	Intervention	1.68	1.67	1.17-3.17	0.001**
	Control*	2.37	2.33	1.83-3.33	
Day 3	Intervention	1.42	1.33	1.00-2.50	0.001**
	Control	2.20	2.17	1.67-3.17	

**p-value <0,05 (there is a significant difference)

The results of the bivariate analysis showed that there were significant differences in mean pain intensity score between the control group and the intervention group on measurements of 1st, 2nd, and 3rd days (p-value = 0.001; α <0.05). In the measurement of mean score pain interference, there was a significant difference between the control group and the intervention group on measurements of 1st, 2nd, and 3rd days (p-value = 0.001; α <0.05).

Friedman test results obtained p-value <0.05, meaning that there were at least two different measurements of mean pain intensity score in the intervention group and mean pain interference score that was significantly different in the intervention group and the control group. Whereas in the control group, the ANOVA Repeated Measure Test was obtained p-value <0.05, meaning that there were at least two significantly different mean score pain intensity measurements.

Table 4 Analysis of Friedman Test Results and ANOVA Repeated Measure Mean Pain Intensity Score & Mean Pain Interference Score in the Intervention and Control Groups at Harapan Kita Heart and Vascular Hospital in March-April 2019 (N=60)

		Uji Friedman		
Mean Score	**Group**	**Measurement**	**Median (Min-Max)**	**p-value**
Pain Intesity	Intervention	Day 1	4.00 (2.75-5.75)	0.001**
		Day 2	2.75 (1.75-2.50)	
		Day 3	2.25 (1.75-4.00)	
Pain Interference	Intervention	Day 1	2.00 (1.67-4.00)	0.001**
		Day 2	1.67 (1.17-3.17)	

		Day 3	1.33 (1.00-2.50)	
	Control	Day 1	2.67 (1.83-3.50)	0.001**
		Day 2	2.33 (1.83-3.33)	
		Day 3	2.17 (1.67-3.17)	
Repeated Measure ANOVA				
Mean Score	**Group**	**Measurement**	**Mean±SD**	**p-value**
Pain Intensity	Control	Day 1	4.88 (0.61)	0.001**
		Day 2	4.54 (0.62)	
		Day 3	0.57 (0.57)	

**p-value <0,05 (there is a significant difference)

Table 5 Analysis of Post Hoc Wilcoxon Test Results and Pairwise Comparison of Mean Pain Intensity Score and Mean Pain Interference Score in the Intervention and Control Groups at Harapan Kita Heart and Vascular Hospital in March-April 2019 (N=60)

Post-Hoc Wilcoxon				
Mean Score	**Group**	**Measurement**	**Mean Rank**	**p-value**
Pain Intensity	Intervention	Hari ke-1 vs Hari ke-2	15.50	0.001**
		Hari ke-1 vs Hari ke-3	15.50	0.001**
		Hari ke-2 vs Hari ke-3	13.00	0.001**
Pain Interference	Intervention	Hari ke-1 vs Hari ke-2	14.50	0.001**
		Hari ke-1 vs Hari ke-3	15.50	0.001**
		Hari ke-2 vs Hari ke-3	11.50	0.001**
	Control	Hari ke-1 vs Hari ke-2	11.00	0.001**
		Hari ke-1 vs Hari ke-3	14.50	0.001**
		Hari ke-2 vs Hari ke-3	12.67	0.001**
Pairwise Comparison				
Mean Score	**Group**	**Measurement**	Mean Different	**p-value**
Pain Intensity	Control	Hari ke-1 vs Hari ke-2	0.34	0.001**
		Hari ke-1 vs Hari ke-3	0.69	0.001**
		Hari ke-2 vs Hari ke-3	0.35	0.001**

**p-value <0,05 (there is a significant difference)

The results of the further analysis showed that comparison of mean pain intensity score measurements in the intervention group 1st vs 2nd day, 1st vs 3rd day, and 2nd vs 3rd day using Post Hoc Wilcoxon obtained p-value <0.05. Thus it can be concluded that the difference was significant in all measurements. Whereas in the control group, comparison of measurements of mean pain intensity score of 1st vs 2nd day, 1st vs 3rd day, and 2nd vs 3rd day using Pairwise Comparison Bonferroni obtained p-value <0.05. Thus it can be concluded that the difference was significant on all measurements.

Comparison of measurement of mean pain interference score 1st vs 2nd day, 1st vs 3rd day, and 2nd vs 3rd day using Post Hoc Wilcoxon obtained p-value <0.05. Thus it can be concluded that the difference was significant in all measurements both the intervention group and the control group.

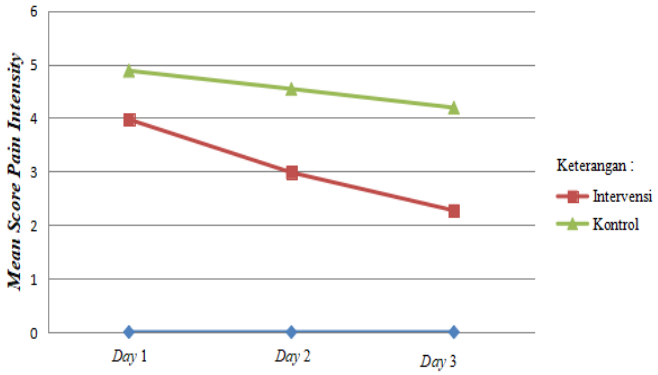

Figure 1 Graph of Mean Pain Intensity Score

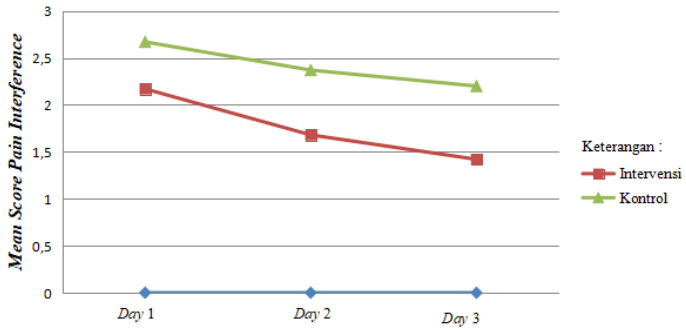

Figure 2 Graph of Mean Score Pain Interference

DISCUSSION:

Age. The Merriam-Webster Dictionary (2017) in Gabriela et al (2017), explains that middle age is 45-64 years. This age has an increased risk of multiple cardiac diseases, which affects the heart and coronary artery system. There are several risk factors that contribute to the process of heart diseases such as smoking, diet, high blood pressure, hypercholesterolemia, diabetes mellitus, and obesity. At the age of middle age, there is also a change in higher sensitivity to the stimulation produced and a decrease in pain inhibiting mechanism (Riley et al., 2014).

Gender. The gender of respondents who undergoing cardiac surgery is mostly male by 61.67%. This is in line with research by Zencir & Eser (2016), showing that the majority of respondents who undergoing cardiac surgery are men by 63.9%. Moderate to severe pain in patients undergoing elective cardiac surgery (coronary bypass surgery or valve replacement) occurring within the first 4 days postoperatively significantly higher pain scores with a numerical rating scale (NRS) in female patients compared male (p-value = 0.03; α <0.05) (Pereira & Pogatzki-Zahn, 2015).

Marital Status. Most respondents are married by 78.33%. This is in line with the research of Keawnantawat et al (2018), showing that the majority of respondents are married at 55.71%. Patients who are single or do not have partners (widow or widower) reported a lack of social support. Single, divorced, or widowed women have less hope compare to patients who have partners. Support can reduce physical stress (induced physical) and psychological stress (for example, depression and anxiety). Patients with anxiety disorders and depression develop neurobiological changes, namely the activation of neurotransmitters such as serotonin and noradrenaline which play a role in pain modulation (Bjornner et al., 2018; Costa et al., 2015).

Level of Education. The education level of respondents who undergoing cardiac surgery is mostly senior high school at 45%. This is in line with the research of Subramanian et al (2014), showing that there is a significant relationship between the level of education and the level of satisfaction with postoperative pain (p-value = 0.001; α <0.05). Most respondents who are satisfied with postoperative pain that secondary education levels of 93.8%, while respondents who are dissatisfied with

postoperative pain that is mostly tertiary education levels at 44.4%. Patients who have high levels of education, objectively demand to receive good quality health care but are subjectively dissatisfied because of their high expectations.

Surgical History. Surgical history respondents who undergoing cardiac surgery is mostly never had surgery before (any type of surgery) by 76.67%. This is in line with the research of Keawnantawat et al (2018), showing that the majority of patients undergoing cardiac surgery did not have a previous surgical history of 60%. There is a significant relationship between the history of surgery with the level of patient satisfaction with postoperative pain (p-value = 0.032; α <0.05) (Subramanian et al., 2014).

The results of the further analysis show that patients who have never undergone surgery before (have no previous history of surgery) have a risk of 13.38 times experiencing dissatisfaction with postoperative pain compare with patients who have to undergo previous operations (p-value = 0.025; 95% CI 1.39, 128.4). Previous personal experience, knowledge, expectations of postoperative pain, and relative changes in pain from pre-operative to post-operative. Dissatisfaction with postoperative pain in patients who have never undergone surgery is caused by a lack of knowledge of ways to reduce pain (Subramanian et al., 2014).

Type of Surgery. CABG and valves are the most types of operations, 43.33%, and 16.67%. This is in line with the research of Keawnantawat et al (2018), showing that most types of operations undergoing CABG and valves in the amount of 34% and 29%. Patients who underwent surgery using cardiopulmonary bypass (CPB) have a higher pain intensity than patients who did not use CPB. Extracorporeal circulation is basically associated with the induction of systemic inflammatory response syndrome (SIRS) with potential end-organ dysfunction. Pain is a subjective sensation and every surgical patient can feel it in a different way even if the type or type of surgery is the same. Pain perception is influenced by factors not only related to surgical trauma and anesthetic methods, but also due to biological, psychological, and sociological factors (Zubrzycki et al., 2018).

Wound Area. The number wound of postoperative mostly in patients undergoing cardiac surgery is 1 wound area of 53.33%. This is in line with research conducted by Keawnantawat et al (2018), the majority wound is 1 area of 54.00%. The extent of the incision is an important factor affecting the intensity of postoperative pain. Postoperative pain is caused by tissue or organ damage during intraoperative and intensity and extent of the wound. In cases of large trauma, patients can experience somatic pain (superficial and deep somatic) as well as visceral components. This can cause pain triggered by smooth muscle contractions caused by compression and tension in the visceral structures and inflammatory lesions (Zubrzycki et al., 2018).

Morphine. Morphine is a therapeutic protocol given to patients after cardiac surgery of 10-20 mcg/kg/hour. The mean use of morphine after cardiac surgery patients in the first 72 hours in the intervention group was 204 mcg/Kg. While the mean morphine in the control group is 245 mcg/Kg. Keawnantawat et al (2018) in his study show that the mean morphine dose after cardiac surgery patients in the control group is 4.7-9.33 mg/day, while the mean in the control group is 4.96-10.63 mg/day.

Morphine is an opioid agonist that has the greatest affinity for μ receptors (major analgesic receptors). M receptors are found in

the brain (posterior amygdala, thalamus, hypothalamus, and caudate nucleus), spinal cord, and other tissues outside the central nervous system (vascular, heart, lung, immune system, and digestive tract). Morphine exerts an effect on the central nervous system by inhibiting the transmission of pain signals, altering the response of pain, sedation, respiratory depression, coughing, and miosis. Whereas Paracetamol inhibits the cyclooxygenase enzyme to reduce prostaglandin production. The role of prostaglandins in the process of pain and pain is suppressed so that it can increase the pain threshold (Vallerand & Sanoski, 2019).

Mean Score Pain. Statistical analysis shows that there are significant differences in mean pain intensity and mean pain interference score between the control group and the intervention group on measurements of 1st, 2nd, and 3rd days (p-value =0.001; α <0.05). An analysis of differences in pain scores when coughing is effective found that there are significant differences in the pain score when coughing is effective between the intervention group and the control group on measurements of 1st, 2nd, and 3rd days (p-value = 0.001; α <0.05).

The results of further analysis of the measurement of mean pain intensity score in the intervention group using Post Hoc Wilcoxon obtained p-value <0.05, meaning that there are significant differences in all measurements. Whereas the control group with Pairwise Comparison Bonferroni obtained p-value <0.05, meaning that there are significant differences in all measurements. Measurement of mean pain interference score using Post Hoc Wilcoxon obtained p-value <0.05, meaning that there are significant differences in all measurements both the intervention group and the control group.

According to the results of research conducted by Keawnantawat et al (2018), there is a significant decrease in mean pain scores in the intervention group compared with the control group patient with cardiac surgery patients after cold therapy (p-value <0.001; α <0.05). Other results also show a significant difference between the control group and the intervention group patient with cardiac surgery patients after being given a gel pack (p-value <0.001; α <0.05). Most patients are given cold therapy with gel packs want to repeat for the use of gel packs by 90% of respondents (Khalkhali et al., 2014).

Tissue damage occurs due to neurogenic inflammation at the site of trauma with symptoms of edema, redness, and pain. These symptoms are the result of the release of potassium ions, bradykinin, prostanoids, and various inflammatory mediators such as substance P, serotonin, histamine, cytokines, and leukotrienes from cells. The release of neurotransmitters and inflammatory mediators causes changes in the sensitivity of the primary afferent nerve terminal. Changes in the environment can also activate sleeping nociceptors. The process is accompanied by changes in the central nervous system (central sensitization) (Zubrzycki et al., 2018).

This phenomenon is manifested in the form of excessive response to painful stimulation in postoperative wounds (primary hyperalgesia) or pain in the surrounding tissue (secondary hyperalgesia). Postoperative acute pain is also classified as receptor pain, which is the same as physiological (caused by stimuli that are not harmful to tissue). This is caused by irritation to pain receptors (nociceptors). In the transduction process, the nociceptors are located in the peripheral terminals of delta A and C fibers, the conversion of energy from hazardous stimuli (mechanical, thermal, and chemical) into electrical impulses (Zubrzycki et al., 2018).

Nociceptor information is conduced along delta A and C fibers to the ganglia from the posterior root or ganglia from the cranial nerve (V, VII, IX, and X), and subsequently to the dorsal horn from the spinal cord. From the dorsal horn, pain stimuli are transmitted through lateral and medial spinohypothalamic, spinomesencephalic, and spinoreticular pathways to the thalamus, reticular formation, the pons, hypothalamus, and periaqueductal gray matter. Furthermore, nociceptor information is transmitted to the cerebral cortex and limbic system. In the transmission process, nociceptor stimulation is inhibited or increased due to the involvement of endogenous and noradrenergic, cholinergic, serotonergic, and Ɣ-aminobutyric acid-ergic systems. The final perception of pain occurs in the cerebral cortex (Zubrzycki et al., 2018).

The mechanism of action of cold therapy is to manipulate the natural mechanism of pain according to the gate control theory. Giving cold therapy by using gel packs can stimulate the conduction of large pain nerve fibers and transmission of small pain fibers is reduced and the gate will be closed (change the speed of nerve conduction, inhibit nociceptors). Inhibition of nociceptors due to the administration of cold therapy can inhibit information that will be transmitted to the cerebral cortex and limbic system so that the perceived pain is reduced or lost (Keawnantawat et al., 2018; Khalkhali et al., 2014).

CONCLUSION:

Statistical analysis shows that there are significant differences in mean pain intensity and mean pain interference score between the control group and the intervention group on measurements of 1st, 2nd, and 3rd days (p-value = 0.001; α <0.05). Cold therapy can be used as an independent nursing intervention for acute pain nursing problems after cardiac surgery patients. The application of advanced EBN can be applied to provide cold therapy with a longer duration after cardiac surgery patients who experience pain when deep breathing and coughing effectively.

LIMITATION:

A limitation in the application of EBN is Morphine therapy which is given as a standard procedure after cardiac surgery patients, which is 10-20 mcg/Kg/hour. However, in practice, not all patients receive the same dose of both the control group and the intervention so that it can affect the outcome of the intervention and can be biased.

ACKNOWLEDGE:

The researcher would like to thank the Harapan Kita Heart and Vascular Hospital and the respondents who assisted in obtaining data and were willing to take the time to be involved in implementing EBN.

REFERENCES:

1) Bjornnes, Ann Kristin., Parry, Monica., Lie, Irene., Falk, Legard., Rustoen, Tone. (2018). The association between hope, marital status, depression and persistent pain in men and women following cardiac surgery. BioMed Central, 18 (2).
2) Costa, Mario A.C., Trentini, Conrado Auer., Schafranski, Marcelo Derbli., Pipino, Oswaldo., Gomes, Ricardo Zanetti., Reis, Elise Souza, D.S. (2015). Factors associated with the development of chronic post0sternotomy pain: a case-control study. Brazilian Journal of Cardiovascular Surgery, 30 (5): 552-556.
3) Herdman, T. Heather., Kamitsuru, Shigemi. (2018). Nursing diagnoses definitions and classification 2018-2020, 7th. Canada: Marquis.
4) Huang, Ana Paula S.H., Sakata, Rioko Kimiko. (2016). Pain after sternotomy.

Revista Brasileira De Anestesiologia, 66 (4): 395-401.

5) Keawnantawat, Pakamas., Thanasilp, Sureeporn., Preechawong, Sunida. (2016). Translation and validation of the thai version of a modified brief pain inventory: a concise instrument for pain assessment in postoperative cardiac surgery. Pain Practice. Doi:10.1111/papr.12524.
6) Keawnantawat, Pakamas., Thanasilp, Sureeporn., Preechawong, Sunida. (2018). Effectiveness of cold therapy in reducing acute pain among persons with cardiac surgery: a randomized control trial. Songklanakarin Journal of Science and Technology, 40 (6): 1378-1385.
7) Khalkhali, Hamid Reza., Tanha, Zahra Ebrahimi R., Ardabili, Shahyad Salehi. (2014). Effect of applying cold gel pack on the pain associated with deep breathing and coughing after open heart surgery. Iranian Journal of Nursing and Midwifery Research, 19 (6): 545-549.
8) Pereira, Manuel P., Pogatzki-Zahn, Esther. (2015). Gender aspects in postoperative pain. Wolters Kluwer Health, 28 (5): 546-558.
9) Riley, Joseph L., et al. (2014). Age and race effects on pain sensitivity and modulation among middle-aged and older adults. The Journal of Pain, 15 (3): 272-282.
10) Subramanian, Pathmawathi., Ramasamy, Suguna., Hoong, Kwan., Chinna, Karuthan., Rosli, Roshaslina. (2014). Pain experience and satisfaction with postoperative pain control among surgical patients. International Journal of Nursing Practice, 1-7.
11) Zencir, Gulbanu., Eser, Ismet. (2016). effects of cold therapy on pain and breathing exercises among median sternotomy patients. Pain Management Nursing, 1-10.
12) Zubrzycki, Marek., Liebold, Andreas., Skrabal, Christian., Reinelt, Helmut., Ziegler, Mechthild., Perdas, Ewelina., Zubrzycka, Maria. (2018). Assessment and pathophysiology of pain in cardiac surgery. Journal of Pain Research, 11: 1599-161