ORIGINAL ARTICLE

Effect of Rhythmic breathing on the Severity of Pain and Anxiety in Patients after Coronary Artery Bypass Graft: a clinical trial study

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ABSTRACT

Aim: To determine the effects of rhythmic breathingon pain and anxiety in patients after CABG.
Design: Randomized clinical trial.
Methods:102 patients undergoing CABG conveniently recruited from two general teaching hospitals affiliated to Ahvaz Jundishapur University of Medical Sciences, Ahvaz, Iran. Patients were randomly assigned to an intervention and a control group. Then first day and on the second and third days after surgery the patients were asked to exercise rhythmic breathing three times a day for 20 minutes at 5-minute intervals. Data were collected using Numeric Rating scale and Spielberger State-Trait Anxiety Inventory. The SPSS software (v. 22.0) was used to analyze the data through the Chi-square, independent-sample *t*, Wilcoxon, Mann-Whitney U, ANOVA and ANCOVA
Results: The severity of pain was significantly different in the intervention and control groups on the first ($p=0.036$), second ($P<0.001$) and third ($p=0.027$) days. There was a statistically significant difference between the two groups in terms of anxiety levels before and after the intervention ($p=0.001$).
Conclusion: Rhythmic breathing is recommended as a simple, low-cost and non-invasive method that is accepted by the patients for reducing the pain and anxiety after CABG.
Key words: Coronary Artery Bypass Graft, Pain, Anxiety, Rhythmic breathing

INTRODUCTION

Cardiovascular diseases among the most common diseases in human communities, kill thousands of people each year and are the leading causes of mortality in the United States and around the world(Benjamin et al., 2019).CABG is one of the most valuable and effective methods of treating coronary artery diseases with the aim of improving survival rates and enhancing the patients' quality of life(Açıkel, 2019). Over 500,000 and 17,000 CABG procedures are performed each year in the US and Australia, respectively. In Iran, CABGs constitute 60% of all open-heart surgeries(Rigi, Feizi, Naseri, & Salehi, 2015). The CABG presents satisfactory results, however, is has the pain caused by the nociceptive stimulus from sternotomy within 24 to 72 hours postoperatively as an important cause of mortality and morbidity in the postoperative period, which leads less effectiveness of cough, by adopting a rapid and superficial breathing, and can cause pulmonary complications such as atelectasis(Garbossa, Maldaner, Mortari, Biasi, & Leguisamo, 2009). It also increases the risk of blood stagnation and clot formation and thereby raises the occurrence probability of pulmonary embolism. This pain, which can persist for 6 to 12 months as chronic pain, activates the nervous system and thereby increases cardiovascular function in the form of increased heart rate, elevated blood pressure and higher myocardial oxygen demand(Van Hecke et al., 2017). Recent evidence suggests that pain in more than 75% of patients is not adequately alleviated and that patients undergoing cardiac surgery report painful hospitalization experiences at cardiac intensive care units(van Gulik et al., 2017). Anxiety is a common pre- and post-operative event(Chevillon, Hellyar, Madani, Kerr, & Kim, 2015). The waiting time for heart surgery, hospitalization, fear of death, knowing someone who died of the same disease in the past and fear of the unknown in general can cause anxiety in patients(Bagheri Nesami, Shorofi, Jafari, Khalilian, & Ziabakhsh Tabari, 2016).The pathogenesis of anxiety among patients of heart disease is less well understood. Threat perception and felt need for biological integrity have been consistently shown to have sympathetic nervous system up regulation with excessive catecholamine production, which can result in increased myocardial oxygen demand and chest pain due to elevations in heart rate, blood pressure, and the rate of ventricular contraction(Chaudhury, Saini, Bakhla, & Singh, 2016). Moreover, Pathological anxiety manifests as an excessive worrying thoughts of being disabled, persistent palpitations, headache, and sleep disturbance, butterflies in stomach, persistent frequent urge to pass urine, and generalized muscular tension(Chaudhury et al., 2016). Moreover, anxiety affects patients' efforts at reducing risk factors, different facets of quality of life, therapeutic compliance, exercise programs(Kandola et al., 2018).

The reduction of these symptoms, giving rise to positive feelings and comfort and hope(Garbossa et al., 2009).Postoperative pain and anxiety control is a major challenge that nurses face and for which pharmacological and non-pharmacological methods can be applied. Morphine is the most common drug used for pain relief after cardiac surgery. This opioid can be accompanied by side effects such as nausea, dizziness, somnolence, hypotension and respiratory depression(Jannati & Attar,

2019). Although analgesics are the most effective means of pain control available to nurses, they are not the only method for pain relief. Given their side effects and differences in patient responses to pharmacological methods, it is important to use non-pharmacological approaches along with analgesics to reduce pain and anxiety in patients(Zakerimoghadam, Aliasgharpoor, Mehran, & Mohammadi, 2010). One of the effective ways of reducing postoperative pain is to use the distractions that are applied for relieving acute pain(S. R. Borzou, Akbari, Falahinia, & Mahjub, 2013).Rhythmic breathing is a simple, low-cost, and noninvasive distraction method and a solution for increasing the available oxygen intake that is nowadays embraced by patients for pain relief(Miozzo, Stein, Bozzetto, & Plentz, 2016). Other benefits of this method include its safety, lack of complications, non-toxicity, prolonged applicability and simplicity(Chevillon et al., 2015).This technique leads to cognitive distraction and a change in harmful stimulus structure like pain and stress.Rhythmic breathing prompts patients to mentally respond and behaviorally react to pain and anxiety in a deliberate attempt to trick the mind into feeling distracted from pain. This gives the patients a sense of control over pain and anxiety and mitigates behaviors resulting from pain and anxiety(Bozorg-Nejad et al., 2018).The effectiveness of the rhythmic breathing has been evaluated in orthopedic surgery (Farzin, Zare, Mousavi, Behnam, & Talebi 2018), dressing Change in Patients with Burns(Bozorg-Nejad et al., 2018), hemodialysis patients(S. R. Borzou et al., 2013),and labor(Boaviagem et al., 2017 Feb 1). In Iran, pharmacological methods are currently used to diminish consequences such as pain and anxiety in CABG surgery. However, there are no comprehensive reports on the effects of rhythmic breathing has on relieving pain and anxiety relief in patients after CABG. Accordingly, the present study was conducted to determine the effects of rhythmic breathing on relieving pain and anxiety and on reducing analgesic consumption in patients undergoing CABG.

METHODS

This study was a clinical trial study thatwas conducted in Ahvaz, southwest Iran from March 1st, 2018 to September 1st, 2018. According to the statistical formula$n = \frac{(Z_{1-\alpha/2}+Z_{1-\beta})^2 2S^2}{d^2}$, considering the significance level of 0.05, and power of 0.80 and by considering 10% dropout, 102 patients undergoing CABG in the ICU of Naft Grand Hospital's Department of Cardiac Surgery, Ahvaz, Iran, was determinedand were randomly assigned to an intervention and a control group using permuted block randomization and a size of 4.

The inclusion criteria were being conscious, not being in a critical condition, no history of taking sedatives and antidepressants, not suffering from any known mental illnesses diagnosed by a physician, having the consent to participate in the studyand being 30 to 75 years of age. The exclusion criteria were life-threatening critical conditions that required the transfer of patients to another medical center or death during treatment.

Instruments:

Numeric Rating Scale (NRS) for pain: The scale included a 10 cm horizontal line graded based on the numerical pain scale from 1 to 10. Zero at this scale means no pain, and 10 for severe pain. This scale has been widely used in numerous empirical and clinical pain researches, and its validity and reliability are approved (van Berckel, Bosma, Hageman, Ring, & Vranceanu, 2017). This tool has been used to measure pain in Iran and the reliability of this toolfor pain intensity (Cronbach'sα's) was.90(Miladinia, Baraz, Shariati, & Malehi, 2017).

The SpielbergerState-Trait Anxiety Inventory (STAI-S): Self-reported anxiety symptoms were assessed using the state component of the widely used and extensively validated Spielberger State-Trait Anxiety Inventory (STAI).The state portion of the STAI is a 20-item self-administered instrument designed to measure the presence of anxiety symptoms at the present moment.STAI-S scores range from 20-80, with higher scores indicating more severe symptoms. The STAI scores of < 40 to indicate no or minimal symptoms and ≥40 to indicate the presence of moderate or severe symptoms(Szekely et al., 2007). This inventory adopted to the Iranian population by Cronbach'sα's .97(Kalkhoran & Karimollahi, 2007)

Data collection: The anxiety level was measured by asking the patients to perform the intervention three times on the second postoperative day. Before and after the intervention Spielberger'sSTAI wasgiven to sample and completed. Also during the three days amount of analgesics used and the frequency of use were recorded in the checklist. Each day, to assess the severity of pain before and after the intervention Numeric Rating Scale (NRS) by researcher was given to patient of both group and completed

Intervention: The intervention group was instructed on the proper rhythmic breathing method in a practical way: they were asked to close their eyes, lie on their back (in the supine position), inhale through the nose by counting 1 to 3, hold their breath for a count of 1 to 3, exhale through the mouth by counting 1 to 3 and only focus on air inflow and outflow during breathing. On the first postoperative day (after extubation and regaining consciousness) and on the second and third days after the surgery, the patients were asked to exercise rhythmic breathing three times a day for 20 minutes at 5-minute intervals and each time for one minute according to the specified instructions.During the shift, nurses monitored patients' rhythmic breathing.The control group received routine pain relief interventions that included analgesic administration. They did not receive any routine intervention for anxiety alleviation.

Data analysis: Data were analyzed in SPSS 22, and the normal distribution of the quantitative variables was examined using the Shapiro-Wilk test. The chi-square test was used to examine the relationship between the qualitative variables. The quantitative variables of the two groups were compared using the independent t-test or its nonparametric equivalent (the Mann-Whitney U test).Wilcoxon test,repeated measures ANOVA and ANCOVA were used for data analysis.

Ethical consideration: This study was approved in the ethics committee of the Ahvaz Jundishapour University of Medical Sciences, Iran (IR.AJUMS.REC.1397.570)and IRCT20181123041729N1 at the IRCT Center for Clinical

Trials. Objectives of the study were explained to patients, and they were provided with an opportunity to ask any questions. Written informed consent was obtained from the patients. Participation in the study was voluntary and patients were free to leave the research at any stage of it.

RESULTS

The mean age of the participants was 59.31 ± 9.19 and 61.25±8.26 years in the intervention and control groups, respectively. There were no significant differences between the two groups in age (P =0.265). Nor were there any significant differences between them with respect to gender, marital status, ethnicity, level of education, or history of hospital stay (Table 1).

The results of repeated measures ANOVA suggest that the mean pain scores for the two groups at the end of the study were significantly different accounting for the moderating effect of pain scores at the beginning of the experiment (P<0.0001). At the beginning of the study, there was no statistically significant difference in pain scores between the two groups (P = 0.748).

On the first day after the intervention, the pain score for the control group increased by approximately 4% and that of the intervention group decreased by approximately 11% indicating a statistically significant difference in pain score between the two groups (P = 0.037).

On the second day of the study pre intervention there was statistically significant difference in pain scores between the two groups and pain score in intervention group was lower than the control group. (P = 0.009). On the second day after the intervention, the pain score for the control group increased by approximately 1% that this difference was not statistically significant (P = 0.847)and for the intervention group decreased by approximately 27% indicating a statistically significant difference in pain scores between the two groups (P<0.0001).

On the third day of the study pre intervention there was statistically significant difference in pain scores between the two groups and pain score in intervention group was lower than the control group (P< 0.0001).in this day after the intervention, the pain score for the control group decrease slightly that this difference was not statistically significant (P = 0.283). and for the intervention group decreased by approximately 17% indicating a statistically significant difference in pain score between the two groups (P< 0.0001).(Table 2).(Fig.1).

The results from the analysis of covariance (ANCOVA) point to a statistically significant difference between the mean anxiety scores for the two groups at the end of the study and a moderating effect of anxiety scores at the beginning (P<0.0001). No statistically significant difference was observed between anxiety scores in the intervention and control groups before the study (P = 0.880). However, the anxiety levels of the intervention group decreased significantly after the intervention (P = 0.003). There was a statistically significant difference in the anxiety levels of the intervention group before and after the intervention (p-value= 0.001); however, no such difference was observed in the control group (P = 0.119).(table 3).

The results revealed that the 52.94% regarding the decrease in analgesic consumption in the intervention group were higher than those in the control group, which were unchanged (%47.06). Results from the chi-square test also showed that there were significant differences between the members of both groups in terms of analgesic use. Considering the frequencies and percentages of analgesic use in both groups, rhythmic breathing was the reason behind these significant differences in favor of the intervention group in terms of reduced analgesic consumption in CABG patients.

Figure1**:** the time course of mean pain score between intervention and control group

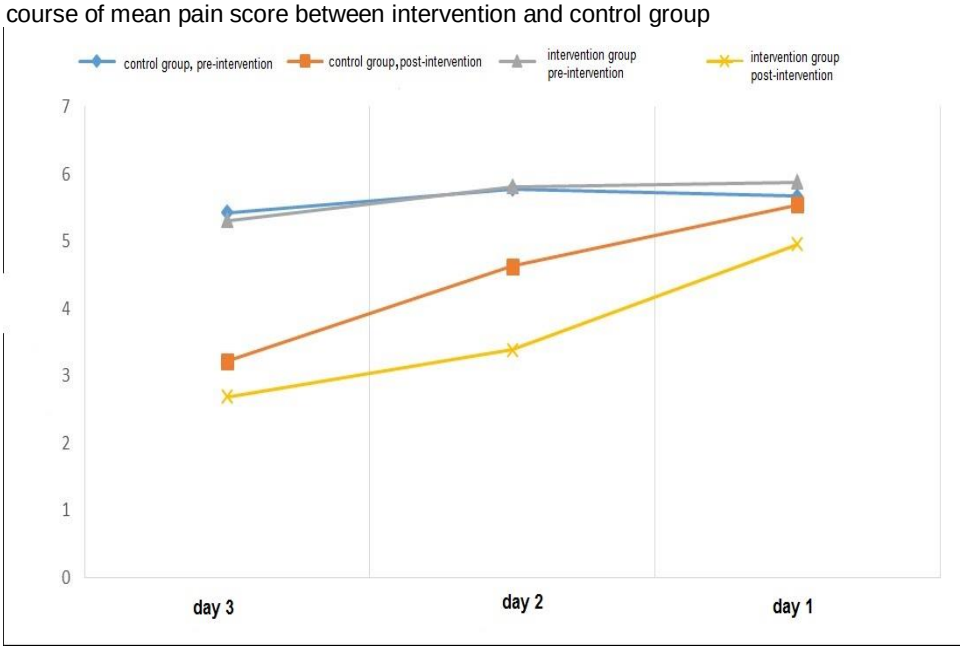

Table 1: Comparison of Demographic Information Divided by Studies Groups

Demographic Information	Control Group	Intervention Group	P-Value
Age	61.25 ± 8.26	59.31 ± 9.19	0.265
Gender			
Male	31 (60.78%)	27 (52.94%)	0.549
Female	20 (29.22%)	24 (47.06%)	
Marital Status			
Married	50 (98.04%)	49 (96.08%)	0.99
Single	1 (1.96%)	2 (3.92%)	
Ethnicity			0.896
Fars	15 (29.41%)	17 (33.33%)	
Lor	15 (29.41%)	16 (31.37%)	
Arab	19 (37.25%)	17 (33.33%)	
Others	2 (3.92%)	1 (1.96%)	
Level of Education			0.681
Illiterate	10 (19.61%)	6 (11.76%)	
Primary school	13 (25.49%)	14 (27.45%)	
Junior high school	11 (21.57%)	10 (19.61%)	
High School Diploma or Higher	17 (33.33%)	21 (41.18%)	
History of Hospital Stay			0.506
Yes	39 (76.47%)	35 (65.63%)	
No	12 (23.53%)	16 (31.37%)	

Table 2: Comparison of Pre- and Post-Intervention Pain Scores in Intervention and Control Groups

	Day 1		**P-Value***	**Day 2**		**P-Value***	**Day 3**		**P-Value***	**P-Value****
Group	Pre-Intervention	Post-Intervention		Pre-Intervention	Post-Intervention		Pre-Intervention	Post-Intervention		
Control	5.76±2.05	5.88±2.22	0.122	5.78±2.20	5.82±2.37	0.847	5.43±2.06	5.31±2.06	0.283	<
Intervention	5.55±2.43	4.96±1.76	< 0.0001	4.63±1.72	3.39±1.28	< 0.0001	3.22±1.17	2.69±1.02	< 0.0001	0.0001
P-Value***	0.748	0.037	-	0.009	< 0.0001	-	< 0.0001	< 0.0001	-	

Value*reported based on Wilcoxon test to compare the mean score of pain in one group before and after the intervention.
P-Value** reported based on repeated measures ANOVA (interaction of day ,measurement time and group in the Generalized Estimating Equations model with ranking outcomes).

P-Value***reported based on mann-whitney test to compare the mean score of pain between the two group

Table 3: Comparison of Anxiety Levels before and after Intervention in Intervention and Control Groups

Variables	Control Group		Intervention Group		P-value
	SD	Mean	SD	Mean	
Pre-Intervention Anxiety Score	1.637	49.51	1.657	49.16	0.880
Post-Intervention Anxiety Score	1.809	49.12	1.341	42.35	0.003
Intra-group P-value	0.119		0.001		-----

DISCUSSION

The findings of the present study suggested that there was a slight increase in the pain scores for the control group on the first day after the intervention, whereas the corresponding scores for the intervention group decreased. Moreover, pain severity decreased significantly more in the intervention group from day 1 to day 3 than in the control group. This demonstrated that rhythmic breathing decreased the severity of postoperative pain in CBAG patients in the intervention group on the first, second and third days after the GBAG procedures.

Bozorgnejad et al. (2017) examined effects of rhythmic breathing on pain resulting from dressing changes in burn patients. They found a statistically significant difference between the intervention and control groups in terms of pain severity in favor of the former (Bozorg-Nejad et al., 2018) which is consistent with the results of the present study. Fallahinia et al. (2013) examined effects of rhythmic breathing on the severity of pain resulting from inserting needles for vascular access in hemodialysis patients. The findings indicated a significant difference in the mean pain severity for the routine and rhythmic breathing procedures (Chevillon et al., 2015). The mean pain severity score was 5.45 ± 1.15 in the non-intervention group and 2.19 ± 0.92 in the rhythmic breathing group. The result of the specified study is in agreement with the present study owing to the similarity of the interventions. Chandrababu et al. (2018) investigated effects of Pranayama breathing technique on anxiety and pain levels in patients undergoing cardiac surgery. The results pointed to a lack of statistically significant difference between the intervention and control groups regarding the pain scores on the fourth and fifth day after surgery, which is inconsistent with the results of the present study in terms of pain scores. This disagreement may be due to the prolonged intervention in the aforementioned study in the third to fifth postoperative days when the condition of patients was improving and they experienced less pain because they had passed the acute phase (Chandrababu,

Kurup, Ravishankar, & Ramesh, 2019 Jan 31).Taghaddosi et al. (2016) studied effects of Sukha Pranayama on anxiety levels in patients undergoing coronary angiography. The results showed that anxiety levels decreased significantly in the intervention group, and that there was a statistically significant difference between the intervention and control groups regarding anxiety Levels (Bidgoli, Taghadosi, Gilasi, & Farokhian, 2016). The result of this study is in line with the present one, which could be accounted for by the relative similarity of the interventions (breathing exercises were used in both).

Junior et al. (2016) examined effects of breathing patterns on maternal anxiety in the active phase of the first labor stage. The results showed that there were no statistically significant differences between the intervention and control groups regarding the anxiety levels two hours after the intervention (Boaviagem et al., 2017 Feb 1). These results are inconsistent with those of the present study regarding anxiety levels, which may be due to differences in intervention methods and statistical populations.

Borzou et al. (2002) studied effects of rhythmic breathing on pain severity and analgesic consumption after orthopedic surgery. The results revealed that the intervention group received analgesics significantly less frequently than the control group within the first 24 hours (S. Borzou, Akbari , Falahinia, & Mahjub 2003). The result of this study is in agreement with the present research in terms of the frequency of analgesic consumption, which may be due to the similarity between the interventions types.

Nasiri et al. (2014) investigated effects of reciting the word "Allah" on analgesic consumption after cardiac surgery and demonstrated that there were no statistically significant differences between the intervention and control groups in terms of the frequency of analgesic administration within the first 24-48 postoperative hours (Nasiri, Fayazi, Jamshidifar, & SheikhZayeri, 2014). The results of this study are inconsistent with the present study in terms of the frequency of analgesic administration, which may be explained by the different intervention types.

CONCLUSION

Considering the results of the present research, rhythmic breathing as a distraction method used together with other pharmacological and non-pharmacological methods of pain and anxiety management can contribute significantly to enhancing the quality of life of CABG patients during the treatment period. Encouraging the use of these methods can be effective in the establishment of a close relationship with the patient and in the patient's acceptance of the treatment. It can also improve the social status of nurses and the perception that the public has of the nursing community.

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Conflict of Interest: The authors declare that there is no conflict of interest regarding the publication of this article.

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