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Address: Mashhad Nursing and Midwifery School, Ebn-e-Sina St., Mashhad, Iran
P.O.Box: 9137913199
Tel.: (098 51) 38591511-294
Fax: (098 51) 38539775
Email: EBCJ@mums.ac.ir

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Original Article

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Effect of Instructional Videos on Postoperative Respiratory Function in Patients Undergoing Off-Pump Open Heart Surgery

Amirreza Salehmoghaddam[1], *Amir Zoka[2], Seyedreza Mazlom [3], Shahram Amini [4]

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Abstract

Background: Respiratory function in patients undergoing open heart surgery is disrupted after surgery. Patient education on managing complications can reduce occurrence or severity of them. A variety of educational tools has been introduced, but there are controversies about the most appropriate tools.

Aim: to determine the effect of instructional videos on respiratory function of the patients after off-pump open heart surgery.

Method: This single-blind randomized clinical trial was conducted on 60 patients undergoing open heart surgery hospitalized at open heart surgery ward of Imam Reza (AS) hospital in Mashhad, Iran, in 2015. The patients were randomly allocated to intervention and control groups of 30 subjects. The instructional video during a 15-minute session was displayed in the intervention group and the control group educated by pamphlet and face-to-face training the day before the surgery. The respiratory function was assessed in both groups. Data were using SPSS version 11.5 software.

Results: The means age of patients were 57.5±4.8 and 56.2±4.2 years in the intervention and the control groups, respectively. The difference of the PF ratio 24 hours after extubation compared to 30 minutes after extubation in the intervention group was significantly higher than the control group ($P<0.001$), as well as the VC and the FEV1 values 24 hours after extubation statistically in the intervention group were significantly higher than the control group ($P<0.05$).

Implications for Practice: The results suggested superiority of the instructional videos rather than pamphlet and face-to-face training to improve postoperative respiratory function in patients undergoing open heart surgery, indicating that instructional videos considering the patient's educational level and their conditions can be effective in educating patients.

Keywords: Instructional Video, Pamphlet, Thoracic Surgery, Respiratory Function Tests, Patient education, Breathing Exercises

1. Evidence Based Care Research Centre, Instructor of Management Nursing, School of Nursing and Midwifery, Mashhad University of Medical Sciences, Mashhad, Iran
2. MS in Nursing, School of Nursing and Midwifery, Mashhad University of Medical Sciences, Mashhad, Iran
3. Evidence Based Care Research Centre, Instructor of Medical-Surgical Nursing, School of Nursing and Midwifery, Mashhad University of Medical Sciences, Mashhad, Iran
4. Associate professor of Anesthesia, School of Medical, Mashhad University of Medical Sciences, Mashhad, Iran

* Corresponding author, Email: Zoka.am69@Gmail.com

Introduction

The heart surgery is a widely used therapeutic approach in the patients given the increasing rate of cardiovascular disease (1). Annually over a million coronary artery surgeries have been performing in the world and 30 to 40 thousand heart surgeries in Iran (2). Although, this surgery gives life back to many patients, but creates numerous complications for the patient usually due to its breadth, which lack of proper control have detrimental impacts on the outcomes of the operation and health of patients (1).

Reduced thoracic stability occurs because of median sternotomy in these patients; pain and drains are also leading to low volume of lungs, which in turn decreases the expiratory flow rate, and thus reduces the effect of cough. In addition, low volume of lungs affects the deep breath mechanism, which may cause pulmonary atelectasis, changes in gas exchange, hypoxemia, decreased pulmonary compliance and increased work of breathing after heart surgery (1, 3).

Reported pulmonary complications after heart surgery include atelectasis, pleural effusion, pulmonary edema, bronchospasm, dyspnea, cough, pneumonia, respiratory failure and diaphragm dysfunction (4). The severity of pulmonary dysfunction after heart surgery could be because of preoperative factors, such as smoking habits, obesity, lung disease and advanced age of the patient. Postoperative factors in this regard are the induction of anesthesia and its duration, malfunction of the diaphragm, immobilization, use of analgesics and hypnotics abdominal distension, thoracic changes, pleural effusion, pain, surgical damages and emergency surgery (1, 5, 6). These risk factors increase the complications of heart surgery as well as cause the prolonged hospitalization and delayed discharge from hospital. Therefore, the management of postoperative complications has of great importance by educating patients concerning health care such as deep breathing and effective coughing. Because deep breathing exercises, such as breathing with whole lung capacity and with emphasis on the use of diaphragm can open the alveoli and improve postoperative hypoxemia (7). This training is one of the responsibilities of nurses, which proper implementation can reduce the cost and duration of hospitalization (8, 9).

According to the studies conducted, shortage of time among nurses and lack of proper training means are the main obstacles to provide appropriate patient education (8, 9). Therefore, pick out the perfect training tool would have significant impacts on patient education in order to control the postoperative complications.

At present, the majority of patients routinely receive instructions about the postoperative care activities by the nurses at the bedside or through written tools such as educational pamphlet during a brief training session prior to surgery (10). Although, these methods are cheap, available and usable in crowded medical centers, but one of the limitations is that they are unsuitable for patients with low education level. Hence, relying on the reading ability of patients is one of the disadvantages of educational pamphlet. In addition, there is no possibility of displaying practical self-care activities, such as deep breathing and effective coughing (11-13). The use of other tools like written, audible and visual information has been proposed to patients for providing information. Many studies have shown that the patients benefit from this information, and some other believes that there is no huge difference among these tools (14).

Instructional videos can provide information about postoperative care in more detail to patients with different educational levels (14). Providing stepwise trainings with frequent reviews can be the other advantages of these tools. Moreover, there is the possibility of displaying a deep breathing and effective coughing via these tools, which are often usable for patients with lower educational levels (13, 15 and 16). However, Jamshidi et al. (2011) demonstrated that there was no statistically significant difference for the incidence rate of complications after coronary angiography among patients in both control (oral education) and intervention (instructional videos) groups (21).

Little studies have been done on the impacts of educational tools so far and contradictory results can be observed. There are also differences among cultures and educational facilities of hospitals in different countries. Failure to report clear and effective educational methods on postoperative respiratory complications in patients undergoing open heart surgery (17, 18) is probably due to not using proper and complete training methods. Therefore, presenting a suitable educational package and determining the best means of providing information to patients before surgery appear to be essential, which can be effective on postoperative respiratory function in this group of patients, and thereby can

prevent or reduce respiratory complications. Hence, the present study was conducted to determine the effect of instructional videos on respiratory function after off-pump open heart surgery.

Methods

This single-blind randomized clinical trial (Statistical analyst was unaware of groups) was conducted from September 2015 to December 2015. The study population consisted of all patients undergoing open heart surgery hospitalized at open heart surgery ward of Imam Reza (AS) hospital in Mashhad, Iran. Participants were recruited easily and entered the study with obtaining written informed consent, and then assigned randomly into two groups: control (routine training) and intervention (education through instructional videos). The minimum sample size was calculated from the formula "comparing two independent society" on 20 patients (10 patients in each group) using the preliminary study. The maximum calculated sample size was related to vital capacity (VC), respectively 42.7±5.8 and 38.0±6.2 in the intervention group and the control group. Thus, the sample size was estimated to be 25 patients in each group by confidence level of 95% and power of 80%; finally, 30 patients were examined in each group.

Inclusion criteria were aged between 18 and 64 years, GCS score higher than 12, having the minimum level of literacy, the ability to communicate and speaking, no history of heart surgery, lack of preoperative pulmonary disease. Exclusion criteria were unwillingness to continue cooperation in research, need for cardiopulmonary resuscitation, tachycardia or ventricular fibrillation after surgery, patients with cardiogenic pulmonary edema or severe pleural effusions and pulmonary embolism.

The study tools involved spirometer and measurement device of arterial blood gas (ABG), the patient demographic characteristics questionnaire consisted of 9 supplementary and multiple choice questions about age, gender, education level, income level, drug addiction, smoking, removal time from ventilator, Duration of stay in the ICU (intensive care unit), surgical time and measurement of pain through Numerical Rating Scale (NRS). The entry form of respiratory indicators included arterial oxygen saturation (SaO2), PaO2/FiO2 Ratio (PF ratio), forced expiratory volume in 1 second (FEV1) and vital capacity (VC). Ten members of the faculty of the Department of Medical-Surgical Nursing, School of Nursing and Midwifery, Mashhad, explored and approved content validity of these two forms. Agreement among observers method by calculating Cronbach's alpha coefficient was used to assess reliability of the entry form of respiratory indicators (r=0.85).

The spirometer is a small device to check the status of a patient's respiratory function (VC and FEV1); the patient did inhale and exhale in it and device according to the incoming parameters and analyzing the data displayed the results, and it was used as a determinant of VC and FEV1 in the present study. The validity and reliability of the device is approved because the construction of reputable MIR-Spirolab 2 company in accordance with the ATS/ERS standards. The ABG samples were taken to assess the PF ratio and the SaO2 level, in this way that codes assigned to intervention and control groups (A, B) were written on two identical sheets and thrown into a box. Training took place every other week to avoid contact and exchange of information among patients, a week to the intervention group and another week to the control group using the draw, this process continued until the completion of the sample size. Training was provided in both groups the day before surgery. In addition, the levels of VC and FEV1 were measured by spirometer before the intervention.

In the intervention group, an instructional video about postoperative measures (deep slow breathing, pain control) was displayed in a patient's room during a 15-minute session the day before surgery. The instructional video was along with explanations on the film, which was designed based on surveys of professors, nurses, supervisors, experts, experienced researchers and feel the need to help patients, and then approved by faculty members, administrators and practitioners of open heart surgery wards and intensive care at Imam Reza (AS) hospital of Mashhad and eventually was used for training. The film could be installed on the phone and even was sent to patients via Bluetooth. The content of the training included the following topics:

1- How to slow deep-breathing exercises,

2- The method of controlling pain when breathing to prevent the onset of pain, and the impact of pain on patient's breathing and pulmonary complications,

3- Correct technique of coughing to avoid pain in surgical site and its impact in preventing postoperative pulmonary complications

4- Pulmonary complications and its effects on pulmonary function (Table 1).

Questions raised by the patient or the patient's family were answered after showing of the film. The nurses taught the same content to patients in the control group in the form of pamphlets and face-to-face training, and the research team supervised the correctness of this delivery. Moreover, the nurses taught other routine training to both groups during hospitalization. All routine postoperative therapeutic interventions of the hospital were provided for both groups of patients. Half an hour and 24 hours after removing the patient from the ventilator and extubation of the trachea, the ABG samples were taken to evaluate the PF ratio and the SaO2 level. The patient pain was measured using NRS, 24 hours after extubation. Then again, the VC and the FEV1 of patients were measured by spirometer.

Table 1: Details of educations provided to patients in the two intervention and control groups

Groups	Objective	Time	Educations
Intervention	Patient education with the management of post-operative complications, pain control and conditions	15	Instructional videos by researcher
Control	Patient education with the management of post-operative complications, pain control and conditions	-	Pamphlet and face to face education by nurse

Ethics Committee approval of Mashhad University of Medical Sciences and written informed consent from patients participating in this research were obtained because of moral considerations. The ethics codes of Mashhad University of Medical Sciences associated with this research were respected.
Once the data were collected and coded, entered into the computer. And, after ensuring the accuracy of data entry, data were analyzed using SPSS version 11.5 statistical software and descriptive statistics (for summarizing the data) and the Kolmogorov-Smirnov test, Independent t-test, Mann-Whitney, paired t-test, Wilcoxon, Chi-square , Friedman's test and Exact Chi-square.

Results

Sixty patients studied were composed of 50% (n = 15) females and 50% (n=15) males in the intervention group, and 43.3% (n=13) females and 56.7 (n=17) males in the control group. The chi-square test results showed no significant difference in this respect between the two groups (p=0.26). The mean age of patients was 57.5±4.8 years and 56.2±4.2 years in the intervention and control groups, respectively (ranged between 48 and 75 years old), which according to the independent t-test no significant difference was observed between the two groups (P= 0.26). Table 2 presents other demographic characteristics, clinical data of subjects and homogeneity of the two groups using chi-square test, exact chi-square and Mann-Whitney tests.
The Mann-Whitney test result demonstrated no statistically significant difference between the SaO2 level 30 minutes and 24 hours after extubation between the intervention and the control groups (P>0.05). The Wilcoxon test result showed that the SaO2 level in both intervention (P=0.47) and control (P=0.90) groups during various stages of assessment did not change significantly (Table 3).
The PF ratio 30 minutes after extubation was 152.7±47.3 and 154.5±42.5 in the intervention and the control groups, respectively. The result of independent t-test showed no statistically significant difference between the two groups (P=0.87). At 24 hours after extubation, the Mann-Whitney test results indicated no significant difference between the two groups for the PF ratio (P= 0.92). But the result of independent t-test showed that the difference of the PF ratio 24 hours after extubation compared to 30 minutes after extubation in the intervention group was significantly higher than the control group (P<0.001). The paired t-test result in the intervention group, and the Wilcoxon test result in the control group also showed that the PF ratio 24 hours after extubation was significantly more than 30 minutes after extubation (P<0.05) (Table 3).
The independent t-test results showed that the pre-test FEV1 level had no significantly different between the two groups (P=0.23), but 24 hours after extubation was significantly higher in the intervention group than the control group (P=0.03). The paired t-test results also showed that in both groups, the level of FEV1 within 24 hours after extubation decreased significantly than pre-test (P<0.001) (Table 4).
The pain of patients 24 hours after extubation was 3.0±0.9 and 2.3±0.6 in the intervention group and the control group, respectively. The Mann-Whitney test result showed a statistically significant difference (P= 0.001). Due to inhomogeneity of this variable before the spirometry, Spearman's rank

correlation coefficient test showed that the elimination of the effects of pain before the spirometry, the two groups had no significant effect on respiratory function (VC, P=0.277; FEV1, P=0.371).
The result of independent t-test showed no significant statistical difference between the two groups for the VC before the intervention (P=0.69). However, the Mann-Whitney test showed that the VC level 24 hours after extubation in the intervention group was significantly higher than the control group (P=0.01). The paired t-test and the Wilcoxon test results in the intervention group showed that the level of VC 24 hours after extubation significantly reduced compared to pre-test statistically (P<0.001) (Table 4).

Table 2: Comparison of demographic characteristics of participants in the two intervention and control groups

Variables	Intervention group (n = 30)	Control group (n = 30)	Test result
Gender			
Man	15 (50%)	13(43.3%)	P=0.60*
Female	15 (50%)	17(56.7%)	
Age (years)	57.5±4.8	56.7±4.2	P=0.25**
Marital status			
Spouse deceased	4 (13.3%)	5(16.7%)	
divorced	3(10.0%)	4(13.3%)	P=0.51***
Married	23(76.7%)	19(63.3%)	
Single			
Education level			
Primary	13(43.3%)	19(63.3%)	
Cycle	12(40.0%)	5(16.7%)	P=0.29****
Diploma	4(13.3%)	4(13.3%)	
Higher Education	1(3.3%)	2(6.7%)	
Income level			
More than enough	4(13.3%)	0(0.0%)	
enough	24(80.0%)	29(96.7%)	P=0.25****
Less than enough	2(6.7%)	1(3.3%)	
Drug addiction			
Yes	8(26.7%)	5(16.7%)	P=0.34*
No	22(73.3%)	25(83.3%)	
Smoking			
Yes	8(26.7%)	12(40.0%)	P=0.27*
No	22(73.3%)	18(60.0%)	
Removal time from ventilator(hours)	7.2±1.4	8.4±4.5	P=0.13****
Duration of stay in the ICU (hours)	62.0±12.4	57.4±12.2	P=0.25****
Surgical time (hours)	3.0±0.7	2.9±1.0	P=0.69**

*: Chi square
**: Independent t-test
***: Exact Chi square
****: Mann-Whitney

Table 3: Comparison of the SaO2 level and the PF ratio after intervention in the two intervention and control groups

Variables		Intervention group	Control group	Inter-group comparison
SaO2 Mean± SD	30 minutes after extubation	95.8±1.5	95.6±1.3	P=0.54*
	24 hours after extubation	95.6±1.2	95.6±1.7	P=0.80*
	Intra-group comparison	P=0.46**	P=0.90**	
PF ratio Mean± SD	30 minutes after extubation	152.7±47.3	154.5±42.5	P=0.87***
	24 hours after extubation	159.0±46.2	155.9±42.7	P=0.92*
	Intra-group comparison	P<0.001****	P=0.04**	

*: Mann-Whitney
**: Wilcoxon
***: Independent t-test
****: Paired t-test

Table 4: Comparison of the levels of FEV1 and VC before intervention and after extubation in the two intervention and control groups

Variables		Intervention group	Control group	Inter-group comparison
FEV1 Mean± SD	before intervention	65.9±9.6	68.8±9.4	P=0.23*
	24 hours after extubation	38.2±10.6	32.4±9.7	P=0.03*
Intra-group comparison		P<0.001**	P<0.001**	
VC Mean± SD	30 minutes after extubation	69.5±7.4	70.4±10.0	P=0.69*
	24 hours after extubation	41.7±9.3	34.9±10.7	P=0.01***
	Intra-group comparison	P<0.001**	P<0.001****	

*: Independent t-test
**: Paired t-test
***: Mann-Whitney
****: Wilcoxon

Discussion

This study aimed to determine the effect of instructional videos on postoperative respiratory function in patients undergoing off-pump open heart surgery.

The results indicated that the SaO2 level 30 minutes and 24 hours after extubation had no statistically significant difference between the two groups. Moradyan et al. (2011) showed that breathing exercises have helped to arterial blood oxygen saturation (SaO2) level in patients after coronary artery bypass grafting (CABG) surgery (22). In the present study, the SaO2 level of patients in both groups had no significant difference after the intervention, which was measured using the ABG up to 24 hours after extubation; the reason for these differences in the results could be due to various SaO2 measurement methods and measuring time. But Moradyan et al., evaluated the SaO2 level with pulse oximeter up to 96 hours after surgery, follow-up time is therefore one of the factors affecting the results, especially the level of SaO2 (22). If follow-up time was longer in the present study, different results might be obtained about the level of SaO2.

The PF ratio had no statistically significant difference between the two groups 30 minutes and 24 hours after extubation. However, the difference of the PF ratio 24 hours after extubation compared to 30 minutes after extubation was significantly higher in the intervention group than the control group. Jamshidi and et al., (2011) conducted a survey entitled "Comparison of video education and training of oral satisfaction and postoperative complications in patients undergoing coronary angiography". The results of their study showed that the incidence rate and severity of complications in the first 6 hours after coronary angiography had no significant statistical difference between the two groups (21). Although angiography and open heart surgery complications are different, and the results are not consistent with the present study, but there is the possibility of comparing results due to the lack of similar studies so far, and the aggressiveness of both of therapeutic methods and similarities of disease (coronary artery disease). There is, however, possibility to reduce some complications of surgery or angiography through education. This reduction depends on the type of educational tools used, the patient's previous knowledge, experience and skills of physicians, how to take care of angiography, and the state of coagulation tests, which can affect the outcomes, the incidence rate and severity of complications after angiography; Jamshidi did not control these items in the study. However, other findings of Jamshidi concerning satisfaction shows that instructional video promotes patient knowledge and comfort, which this has led to a significant increase in satisfaction (21); since in instructional video, there is the possibility of displaying animated and practical activities (11-13). The education experts believe that educational tools and methods engaging the senses of sight and hearing of learners lead to learning more and more stable (12, 13), and it is important in learning how to do deep breathing and coughing to reduce postoperative respiratory complications.

The FEV1 levels 24 hours after extubation was significantly higher in the intervention group compared to the control group. Studies show that proper training techniques can improve the FEV1 level (5). In the present study, however, the FEV1 in the instructional videos group was significantly higher than the control group. The results of Ong et al. (2009) study as "Effect of a preoperative instructional digital video disc on patient knowledge and preparedness for engaging in postoperative care activities" showed that educational media could increase knowledge about the postoperative care activities of patients such as the control of pain, effective coughing and deep breathing. Moreover, this method can prepare them and their families to participate in post-operative cares. On the other

hand, the nurses were satisfied with the patient compliance rate and the ease of postoperative care (19). In the present study, we evaluated objectively respiratory function in patients and the effectiveness of this cooperation. The FEV1 level of patients with instructional videos had significant improvement, despite low levels of education among most of them. The advantages of instructional videos or multimedia means were the reasons for inconsistent results. Usability for people with low education levels is the benefits of instructional videos. Instructional videos can also lead to fascinate and encourage patients to do the content taught (13, 15, 16). The educational content in the study was about the impact of pulmonary complications on the respiratory function, which may have stimulated the patients to prevent side effects. As well as, practical training as surgical videos and photos can increase their learning level, which may be due to the long-term maintenance of visual education in mind (20). The patients maybe helped to improve their respiratory function by doing more and more accurate taught self-care activities, such as how to control pain and deep slow breathing after the surgery.

The VC level 24 hours after extubation in the intervention group was significantly higher than the control group. Mladenovski et al (2012) also believe that patient education using multimedia and instructional videos not only can help to improve their cognitive skills, but also enhance their motor skills to perform self-care activities (21).

Results of previous studies also show that deep slow breathing exercises can less reduce the levels of FEV1 and FVC after surgery and patients in the intervention group were better than the control group (5). However, the result of Huber et al., (2013) indicated that the written and audio-visual learning tools had no significantly difference in performance and decisions of patients (23). Because education by using pamphlets and face-to-face training can also cause readiness of the patients and can improve respiratory function. These tools are cheap, available, and more practical to use in populated medical centers. In previous studies, different results have been reported on their impact on knowledge, performance and management of patients (24). But given the low education level of patients referred (especially in educational hospitals), and the possibility of being useless pamphlet, and the need for nurses to understand educational materials, so it will not be useful training tool to teach patients undergoing open heart surgery. Because statistics suggest a lack of nursing staff, their heavy workload and the lack of appropriate educational tools (8, 9), and hence patient education may be neglected.

One of the study limitations was the short-term follow-up. If the follow-up time of respiratory function status in patients were longer in this study, probably more and better results could be achieved. However, this was not possible due to limitations of time and financial resources; it is recommended that this issue should be considered in future studies. Ignoring the drugs received (especially pain reliever) in both groups and anesthesia protocols were some other limitations of the study.

Implications for Practice

Given the better postoperative situation of the variables including PF ratio, VC and FEV1 in patients of instructional videos group as well as facilitating the educational role of the nurses, the instructional films and videos are recommended to be used as a supplement to oral education method in patients undergoing open heart surgery. However, face-to-face training and pamphlets can also be applied by considering the education level, number of personnel and facilities in the wards. The patient education, in addition to helping to increase awareness, causes an increase in their tolerance and cooperation and facilitates postoperative care activities. These cases can improve the respiratory function and reduce postoperative complications. It is suggested that future studies should be done with long-term follow up and the participants must be control for received drugs and anesthesia protocols. It is worth mentioning that this was not feasible in this study given limited time and financial resources.

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Conflict of interest

The authors declare that there is no conflict of interest.

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