

Article

The effect of a smartphone-based perioperative nursing intervention: Prayer, education, exercise therapy, hypnosis, and music toward pain, anxiety, and early mobilization on cardiac surgery

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Abstract

Background: Cardiac surgery can elicit both physical and psychological responses. Prayer, exercise therapy, education, hypnosis, and music are expected to be able to overcome pain, anxiety, and immobilization in the cardiac surgery. This study was to create a smartphone-based peri-operative nursing intervention model that was able to reduce pain, anxiety, and increase early mobilization cardiac surgery patients.

Design and methods: This study consisted of three stages. The first stage was research and development, the second was true experimental design, and the third was cross sectional design. The samples size was 86 respondents. The intervention models for the treatment group comprised of a smartphone-based therapy of prayer, education, exercise, hypnosis, and music. The control group was given standard hospital intervention according to the clinical pathway.

Results: The majority of respondents were adults, male, high school graduate in the treatment group and bachelor graduate in the control group, CABG type of surgery, and having pain history. The intervention had a significant effect on reducing pain scale and anxiety level as well as increasing early mobilization ($p < 0.05$). The intervention had a direct effect on pain and anxiety, but it had no direct effect on early mobilization. However, it gave indirect effect on early mobilization that was mediated by anxiety.

Conclusions: The models can be used by nurses to reduce pain, anxiety and to increase early mobilization on cardiac surgery patients.

Introduction

Heart disease is number one cause of death in the world.^{1,2} Globally, 80% of deaths from coronary heart disease occurs in developing countries including Indonesia.² One of the treatments to overcome it is surgery with 6.7%.³ Cardiac surgery is a very

high-risk procedure that requires special nursing care.⁴ Each peri-operative stage has specific physical and psychological problems.⁵

Physical problems that often arise in the preoperative stage include pain, immobilization, and unstable hemodynamics.⁶ Eighty percent of preoperative cardiac surgery patients with myocardial infarction experience pain.⁷ In fact, it also occurred at Harapan Kita Heart and Blood Vessel Hospital, in Jakarta, where 75% of patients complained of pain before cardiac surgery due to acute myocardial infarction. Psychological problem that frequently occurs in the pre-operative stage is psychological distress⁴ such as anxiety due to unknowing the real condition of what would happen during surgery as well as fear of death. These lead to unpleasant situation and often cause mal-adaptive behavior change responses.⁸

The intra-operative stage begins when the patient gets into the operating room with a conscious condition. This early stage causes the patients' anxiety elevates because they are worried of changes in body structure and function, pain, and the threat of death. The role of nurses at this point of time is very essential in helping patients to reduce anxiety. In the early post-operative stage, several complications might appear such as severe pain, anxiety, risk of bleeding, impaired respiratory function, nausea, vomiting, and unstable hemodynamic status. They are caused by some factors; long recovery of unconsciousness due to the influence of anesthetic drugs, decreased cough reflex due to intubation, as well as airway obstruction due to mucus. When the patients are conscious, other complications come up such as severe pain, fatigue, immobilization, disturbed sleep patterns and self-care deficit. Post-operative pain of cardiac surgery is felt by all patients who undergo it.^{9,10}

Among various nursing intervention models to overcome problems in the peri-operative stage, five nursing therapies can be selected to become a comprehensive combination therapy; consist of prayer, education, exercise, hypnosis, and music. The combination is expected to synergize one another to overcome the problems of pain, anxiety and immobilization during the peri-operative stage of cardiac surgery. Currently, nursing interventions in the

Significance for public health

This research is very important to do because it provides great benefits to the community who will undergo cardiac surgery, so that patients are able to intervene to overcome the problem of pain, anxiety, and immobilization, these abilities have an impact on improving the quality of life during cardiac surgery procedures.

peri-operative unit that are carried out by nurses are still conducted manually referring to standard operating procedures so that the form of intervention to each patient depends on the patient's condition at that time. Hence, it is not standardized and varies greatly in its implementation even though there are standard operating procedures and also clinical pathways. To deal with it, a smartphone-based application is needed. The dominant positive impact of using smartphone-based intervention applications is helping patients and health workers before and after surgery, maintaining interaction between the two in giving education about conditions and procedures, reducing or even eliminating the need for additional therapy, standardizing information to patients, reducing inconsistencies between the information provided by the health workers or the hospital team.¹¹ The goal of the study was to create a smartphone-based peri-operative nursing intervention model that is able to reduce pain and anxiety, as well as to improve early mobilization of cardiac surgery patients.

Design and Methods

This study consisted of three stages. The first stage was the development of nursing intervention model on peri-operative cardiac surgery. The next stage was the examination on the effect of intervention model. The last stage was the analysis on the correlation and effect of exogenous variables on the main endogenous variables including pain, anxiety, and early mobilization. The research design of phase one was research and model development. At this stage, researchers developed intervention model and smartphone applications based on theoretical studies. In addition, the researchers consulted with two experts, information technology and cardiovascular nursing experts, on the operation of smartphone application. Then, the researchers created a smartphone-based application program. It utilized *Analysis, Design, Development, Implementation, and Evaluation (ADDIE)* approach.^{12,13} The second stage of research was model testing with a true experimental design. Researchers randomly divided respondents into the treatment and control groups. The samples size was 86 respondents in which 43 respondents each group respectively. At the third stage, researchers identified the correlation and effect of exogenous variables on endogenous variables with a cross sectional design. The research took a place at National Cardiovascular Center Harapan Kita, Jakarta. This research had passed the ethical clearance test from the Ethics Committee of the Faculty of Nursing, Universitas Indonesia No: SK-70/UN.F12.D1.2.1/ETIK.2020 and from the Ethics Committee of National Cardiovascular Center Harapan Kita Jakarta No. LB.02.01/ VII/517/KEP012/2021.

Results

The results of the first stage of the study, namely, to produce a smartphone-based intervention model, the results of the second and third stages of research are described as follow: The data of the study result were presented below.

Characteristics of respondent

The characteristics of the respondents in the treatment group, most of the respondents are adults (62.8%), male (67.4%). The majority of respondents, graduated from senior high school (39.5%). Then, the type of operation that was frequently taken is

CABG (58.1%). Most respondents, have a history of severe pain (65.1%). Respondents in the control group are adults (43.5%), male (67.4%), and have higher education (Bachelor) (41.8%). The most type of surgery is CABG (62.8%) and have a history of severe pain (72.1%) (Table 1).

Pain scale, anxiety score, and early mobilization after treatment

Table 2 illustrate the data on pain scale on the first, second, and fifth day after surgery, pre-operative anxiety scores, and early mobilization on the first, second, fourth, and fifth day after surgery. It showed a significant difference between treatment group and control group after being given peri-operative nursing intervention model ($p < 0.05$).

Table 1. Characteristics of respondent (N=86).

Characteristics of respondent	Treatment Group (n=43)		Control Group (n=43)	
	N.	%	N.	%
Age				
Teenager	2	4.6	2	4.6
Adult	27	62.8	23	43.5
Elderly	14	32.6	18	41.9
Sex				
Male	29	67.4	30	69.8
Female	14	32.6	13	30.2
Education Level				
Elementary School	5	11.6	4	9.3
Junior High School	6	14	2	4.7
Senior High School	17	39.5	16	37.2
Diploma Program	3	7	2	4.7
Undergraduate Program	9	20.9	18	41.8
Graduate Program	1	2.3	1	2.3
Doctoral Program	2	4.7	0	0
Type of surgery				
CABG	25	58.1	27	62.8
Valve	17	39.5	14	32.6
ASD Closure	0	0	1	2.3
VSD Closure	1	2.3	1	2.3
Pain history				
Yes	28	65.1	31	72.1
No	15	34.9	12	27.9

Table 2. Distribution of t-test on respondents' pain scale, anxiety score, and early mobilization between groups after treatment.

Variable	Treatment (Mean)	Control (Mean)	P-value
Pain Scale-Day 1	2.04	4.60	<0.001
Pain Scale-Day 2	1.23	3.86	<0.001
Pain Scale-Day 5	0.23	1.53	<0.001
Anxiety Score	21.84	56.58	<0.001
Early mobilization-Day 1	3.93	3.49	0.006
Early mobilization-Day 2	5.37	4.53	<0.001
Early mobilization-Day 4	7.28	6.74	<0.001
Early mobilization-Day 5	7.86	7.37	<0.001

Fit model

The third stage of the study examined the correlation and effect of exogenous variables on endogenous variables with a cross sectional design. The analysis output of Structural Equation Modelling (SEM) using M Plus software generated some indexes to assess whether the model is appropriate. The result of Chi Square (X^2) p-value 0.233 ($p > 0.05$), RMSEA 0.042 (< 0.05), CFI 0.965 (> 0.9) and TLI 0.947 (> 0.9). Based on four SEM statistical indexes, it can be concluded that the model intervention fits to the data.

The effect of exogenous variables on pain, anxiety, and early mobilization

Refer to the Table 3, exogenous variable that affected pain is smartphone-based perioperative nursing intervention models ($p < 0.001$). Based on Table 4, exogenous variables that affected anxiety is smartphone-based perioperative nursing intervention models of prayer, education, exercise therapy, hypnosis, and music ($p < 0.001$). Refer to Table 5, exogenous variables that affected early mobilization are anxiety and energy levels ($p < 0.001$). Based on Table 6, the intervention model has a significant effect on early mobilization mediated by anxiety ($p < 0.05$).

Discussion

Both respondents in the treatment and control groups are mostly adult (Table 1). This result is in accordance with research conducted in Xinjiang China that the average age of patients with heart disease is 34.12 years.¹⁴ Adult age is a productive age to work, it is the period at which an increase in welfare begins. As a result, lifestyle changes occur, such as changes in eating habits. Consuming fast food or food with high fat and cholesterol becomes more often. Apart from having a family history of heart disease, hyperlipidemia and hypercholesterolemia are main risk factors for premature myocardial infarction. It mostly occurs at the age of 25-39 years.¹⁵ The result of this study is also supported by research on industrial workers in India. It was revealed that adult workers had more than one risk of heart disease, such as pre-hypertension, pre-obesity, hyper-cholesterolemia, and smoking.¹⁶ The same condition also occurs in valvular heart disease; the results of a study in Brazil reported the average age of patients with valvular heart disease is 45.3 years, although it can occur in all age ranges depending on the cause, and the most common causes are Rheumatic Heart Disease (RHD) and Degenerative Valve Disease.¹⁷ Increasing age also rises the risk of calcification in the heart valves, which will cause an impaired heart valve function.¹⁸

The sex of respondents in this study is mostly male (Table 1). Men are likely to develop the risk of coronary heart disease twice than women.¹⁹ Men are at risk for heart disease due to unhealthy lifestyles such as smoking, alcohol consumption, and unhealthy diets.^{19,20} However, hormonal effect is believed to have a strong contribution to the incidence of coronary heart disease in women. The hormones that play a role are estrogen and progesterone which affect the cycles of menstrual and menopausal. In addition, the use of hormonal contraception is thought to contribute on the incidence of coronary heart disease as well.²¹ The result of another study found that four main risk factors are hypertension, hyperlipidemia, diabetes, depression and anxiety.²² Peri-menopause women can still be at risk of heart disease, one of which is due to obesity. The level of High sensitive C-reactive protein (hsCRP) as a pro-oxidant rises with the increase in the body mass index of peri-menopause women. The level of hsCRP can affect the thickness of

the intima media layer in the coronary arteries.²²

In terms of education background, the majority of respondents in the treatment group graduated from senior high school or its equivalent, while those in the control group are from undergraduate program (Table 1). This result showed that the higher the education, the more knowledgeable the person would be. Hence, it will affect individual's health attitudes and behavior. Day by day, education has become the most common measure of socio-economic status in epidemiological studies. The opinion of this researcher is supported by the results of Winkleby's research in 1992 which stated that education affects the risk factors of cardiovascular disease. When people go into higher education, they become more knowledgeable on the causes of disease and the importance of having treatment once the disease occur.^{23, 24}

Most of the respondents have a history of pain prior to cardiac surgery (Table 1). This is in line with the diagnosis of disease in which most of respondents experience coronary heart disease with more than three blockages (CAD3VD) which was performed by

Table 3. The direct effect of exogenous variables on pain.

Variable	B	P-value
Intervention Model	-0.734	<0.001
Believed in therapy	-0.090	0.210
Pain Experience	0.009	0.901
Sex	0.042	0.579
Age	0.073	0.383
Ethnic	0.045	0.529
Type of Surgery	0.037	0.670

Table 4. The direct effect of exogenous variables on anxiety.

Variable	B	P-value
Intervention model	-0.747	<0.001
Pain	0.044	0.663
Sex	0.055	0.455
Ethnic	0.009	0.899
Stress potential	0.087	0.205
Occupation	0.106	0.151
Emotional maturity	0.015	0.822
Knowledge	-0.030	0.653

Table 5. The direct effect of exogenous variable on early mobilization.

Variable	B	P-value
Anxiety	-0.308	0.041
Intervention model	0.191	0.274
Pain	-0.059	0.673
Energy level	0.191	0.044

Table 6. The indirect effect of exogenous variable on early mobilization.

Variable	B	P-value
Intervention model	0.230	0.048

CABG. Chest pain or angina pectoris occurs as a result of myocardial ischemia that is a symptom of coronary heart disease. Chest pain is a common presentation in both outpatients and inpatients, and frequently it is suspected from the heart of patients with cardiovascular risk factors.²⁵

Pain after cardiac surgery is characterized as acute pain. According to researchers, acute pain arises due to surgical trauma on tissues or organs, as well as due to the surgical wounds. It occurs after discontinuation of the analgesic agent effect administered during intra-operative stage. The pain gets better day by day along with the tissue healing. It is felt by the patient for several days to 10 days, but it can also last up to three months. The authors' opinion is supported by Zubrzycki *et al.*, that tissue damage causes neurogenic inflammation at the trauma site. The area of trauma is swelling, red, and painful. These symptoms are derived from the release of potassium ions, bradykinins, prostanoids, and various inflammatory mediators, such as substance P, serotonin, histamine, cytokines, and leukotrienes from cells. It results in changes in the trauma sites, and peripheral sensitization also occurs.²⁶

The prevalence of anxiety in patients prior to the elective cardiac surgery is reported 80%. Anxiety during surgery can affect the outcome of surgical treatment. In addition, in the post-operative stage, it can affect the prediction of clinical improvement and mental health. Further, anxiety causes hypertension, increased heart rate, and it may lead to bleeding and other possible post-operative side effects. Moreover, long-term anxiety increases metabolism, oxygen consumption, and emotional conception of pain which will lead to poor mobilization process.²⁷

The results of this study agreed to the idea of Kanejima and colleagues that early mobilization is very important to patients with post-cardiac surgery. Cardiac surgery carries a high risk of complications, so post-operative management is needed to minimize pain, dyspnea, sleep disturbances, depression, and immobilization. Immobilization of post-operative cardiac surgery patients contributes to decrease cardiac output, secondary complications such as deep vein thrombosis (DVT), pneumonia, pressure sores, loss of muscle mass and strength, and it decreases aerobic capacity in the first few days after surgery. To prevent this, early mobilization is needed.²⁸ Pain management with hypnosis that becomes part of the intervention model in this study is a comprehensive therapy which is able to overcome the problems that arise in post-cardiac surgery patients both physically such as pain and psychologically such as anxiety and depression. The hypnotic therapy in this study is in line with the results of other researchers stating that clinical hypnotherapy performed before CABG surgery has a beneficial effect on reducing anxiety and stress and has a positive impact on changes in pain perception during the recovery period of patients undergoing CABG.²⁹ In addition to hypnosis, music therapy is also part of the nursing intervention model in this study. Music is believed to provide benefits to patients undergoing cardiac surgery such as reducing pain, anxiety, and blood pressure, increasing oxygen saturation, lowering the need for morphine sulfate, and lifting up mood towards a more desirable state.³⁰ The procedure of hypnosis and music therapy was carried out using video in a smartphone-based application.

The results of this study support the idea on the importance of smartphone. Smartphone is a cellular technology that has benefits in health sector such as standardizing therapy, increasing motivation and adherence to therapy programs, providing health education, making early decisions and observing the intervention.³¹

Hypnosis and music are given to patients according to a pre-determined program in which they can be easily accessed and followed by the patients through their smartphones.³² The findings of this study showed that the interventions are able to give an effect of 73.4% on post-operative pain compared to other variables such as pain experience, age, sex, type of surgery, ethnic, belief in therapy, and other factors that are not examined in this study (residual value 0.423).

The four interventions that were able to reduce peri-operative anxiety in cardiac surgery are prayer, education, hypnosis, and music therapy. Prayer is shown to reduce anxiety, depression and increase hope in cancer patients and surgery patients.³³ The effectiveness of prayer therapy is influenced by the patient's beliefs and culture.³⁴ Prayer therapy in this study was carried out by patients before surgery via video in a smartphone application.

Pre-operative education is comprehensive information provided before surgery on a variety of topics including procedures, preparation, post-operative progress, psychological support, physical preparation, and coping skills. The media used for education can be in various forms. A study by Shuldham in 2002 utilized manuals and booklets, while Sorlie's study in 2007 employed videos that were combined with procedure explanation by a trained nurse. The results of these two studies demonstrated that education reduces anxiety and improve recovery in cardiac surgery patients.³⁵ Rousseaux's research used hypnosis script recording media for 20 minutes which was named "Soothing white clouds" and compared it with virtual reality hypnosis. The results indicated that hypnosis with this technique can increase comfort (reduce anxiety, pain, and fatigue).³⁶ The results of Rousseaux's study support the results of this study in which hypnosis was administered using a hypnosis script spoken by the researcher through video on a smartphone.

Music therapy is defined as using music to assist certain changes in a patient's behavior and feelings. The characteristics of music for therapy are having stable rhythm, preferred, instrumental genre, having 60-70 beats, calming, having sound intensity of 50-60 dB. Music is an in-expensive nursing intervention without side effects and has been proven through various studies to reduce pre- and post-operative anxiety.^{30, 37}

Exercise therapy performed before and after surgery greatly assists patients in improving respiratory function, increasing the functional capacity of various organs, and reducing various post-operative complications, increasing muscle strength, and increasing the ability to move more quickly and even effectively reducing the length of treatment in hospital on post-cardiac surgery patients.^{38,39} So far, it is known that there are several obstacles to perform early mobilization after surgery. They include pain, anxiety, unstable hemodynamics, arrhythmias, delirium, deep sedation, lack of motivation, limited trained staff in assisting mobilization, and a work culture that gives early mobilization less priority.⁴⁰ Anxiety and pain affect an individual to carry out activities including the desire to do early mobilization.

Conclusions

Based on the results and discussion, the model created by the researcher is able to reduce pain and anxiety, increase early mobilization, so this model can be used by health workers, especially nurses to overcome pain, anxiety, and increase early mobilization of peri-operative cardiac surgery patients.

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