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Effect of planned exercises on tissue perfusion improvement post coronary artery bypass graft

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Abstract
Background: Organs and tissue perfusion are generally affected because of intraoperative, respiratory and cardiovascular frameworks after heart surgeries. Nursing activities has crucial benefits on hemodynamic and perfusion boundary. **Aim:** To determine the effects of planned exercise on tissue perfusion improvement post coronary artery bypass graft. A quasi-experimental design was used within the present study. **Setting:** The study was carried out at the cardiothoracic intensive care unit at Assiut University Hospital. **Sample:** A convenience sample of 60 patients with open heart surgery from both sex assigned into two equal groups (control and study groups) from age 18 years and above. **Tools:** Patients assessment sheet that include, part one is concerned with the patient's basic health data and part two involved the hemodynamic indices and tissue perfusion parameters in preoperative and 1st, ,3rd and 5th days post-operative. **Results:** It was revealed that there was a statistically significant difference between the two groups after the surgery as regards to capillary refill on 3rd and 5th day(p=0.002) and also as regards to mean blood pressure on the 3rd day (p=0.017). **Conclusion:** exercise as a part of nursing intervention had a significant impact on tissue perfusion parameter of postoperative cardiac patients. **Recommendation:** planned exercises for postoperative cardiac patients should be offered on a regular basis.

Keywords: Cardiac patients, Exercise & Tissue perfusion.

Introduction
Noninvasive peripheral perfusion monitoring may be a complementary technique that can be implemented quickly in the hospital. Since peripheral tissues are sensitive to perfusion changes, peripheral monitoring may serve as an early indication of tissue hypoperfusion. Noninvasive methods for controlling perfusion in peripheral tissues based on clinical symptoms, body temperature scale gradient **(Hasanin et al., 2017)**

Altered peripheral perfusion is strongly associated with poor outcome in post cardiac surgery patients. It's vital to see if regular tests of peripheral perfusion in the days after surgery will help classify patients who are more likely to have postoperative complications early on. There is growing evidence that altered tissue perfusion in high-risk surgical patients can help identify patients who are at risk for complications and help them recover more quickly **(Van Genderen et al 2014). (Goepfert et al., 2013).**

As a result, their value serves as a base for emphasizing the importance of tracking postoperative early warning signs for occult tissue hypoperfusion. Similarly, lactate level, a possible marker of occult hypoperfusion, is used as a resuscitation target, though the relationship between lactate level and regional circulation is still unknown **(Van Genderen et al, 2014).**

As a result, early detection of regional tissue perfusion defects is critical to preventing further organ damage and improving outcomes after major surgery. Traditional hemodynamic variables, which are considered to be insensitive to determining the presence of regional tissue hypoperfusion, are still used for postoperative monitoring **(Parker et al., 2019).**

Exercise has gained little recognition for its importance in health promotion until recently, and the majority of research on the health benefits of aerobic training has continued to make this form of exercise the primary target of the majority of major health organizations' physical activity recommendations.Physical activity is highly advocated in the consensus statement from the Centers for Disease Control and Prevention and the American College of Sports Medicine to minimize one's risk of cardiovascular disease. The benefits of aerobic and resistance training on cardiovascular risk factors are recorded in this statement. The American College of Sports Medicine (ACSM) concentrated on older people. **(Coelho-Júnior, et al 2017 and Hansen, et al 2018).**

The physiological response to exercise is influenced by the exercise's strength, duration, and frequency, as well as the surrounding conditions. During physical activity, skeletal muscle needs more oxygen and substrate, as well as the removal of metabolites and carbon dioxide. Chemical, mechanical, and thermal stimuli impact metabolic, cardiovascular, and ventilation changes. **(Kaakinen, et al 2018 and MacInnis, & Gibala, 2017).**

The peripheral perfusion index (PPI) and the capillary refill time (CRT) are used to measure the peripheral perfusion time (CRT). Perfusion and microcirculation of the organs are controlled. Inadequate tissue perfusion and oxygenation in critically ill patients are likely to lead to the development of organ failures and increased mortality. As a result, determining the adequate oxygen supply to organs and tissues is important. Since tissue oxygenation is determined by the net balance between cellular oxygen supply and oxygen demand, these parameters remain insensitive measures of hypoxia and are considered weak surrogates for oxygen availability at tissue levels. Furthermore, the fact that persistent regional tissue dysoxia can occur even when systemic blood flow appears to be sufficient, adds to the pressure **(Parker, et al., 2019).**

Resistance training increases strength and muscle mass in older adults via a poorly understood sequence of events that tends to require satellite cell recruitment to promote hypertrophy of mature myofibrils. Resistance training improves muscle quality (strength relative to muscle mass) in older adults for a variety of reasons, including improved capacity.. Resistance training improves strength, decreases the complexity of everyday activities, increases energy intake and body composition, and encourages spontaneous physical activity in older adults. When aerobic training is combined with resistance training, a reduction in strength growth can occur; however, this can be prevented by restricting training to three days per week **(Cardinale, et al., 2011).**

Significance of the Study

Optimization of organ perfusion in high-risk surgical and patients in acute setting, and offers arguments to support the potential utility of tissue oxygen monitoring. Restoration of an oxygen supply sufficient to facilitate adequate cellular perfusion is fundamental in maintaining organ function. This is mainly relevant when metabolic needs change markedly. The consequences of inadequate tissue oxygenation include wound and anastomotic breakdown, organ dysfunction, and death. Exercise is widely recommended to restore organ perfusion following major surgery, maintain health across the lifespan, and improve patients performance. **(Kilgas et al., 2019)**

Aim of the Study

The current study aimed to determine the effects of planned exercise on tissue perfusion improvement post coronary artery bypass graft.

Research hypothesis

Patients who receive planned exercise will be improve mean blood pressure and capillary refill than patients who done not receive.

Subjects and Method

Research Design

A quasi experimental research design was used in this study.

Sample:

The study included a convenience survey of 60 patients from March to December 2019 of both sexes who were post coronary artery bypass graft and were divided into two equal categories (control and study groups). The research included patients with stable cardiovascular and respiratory functions. The study excluded patients with delayed ventilation weaning, bleeding risk, fluid and electrolyte imbalance, and/or fever.

Setting:

The study was carried out in the cardio thoracic intensive care unit at Assiut University Hospital.

Tool of data collection:

The researcher created a patients evaluation sheet for postoperative cardiac patients based on recent literature **(Brustia et al., 2018, & Kondo etal., 2018)** and used it to collect data. It was divided into two parts. **Part one**: preoperative basic health information assessment such as age, gender, weight, occupation, and surgery type**.**

Part two: Noninvasive tissue perfusion parameters which consists: heart rate, central venous pressure (CVP), mean arterial blood pressure (MAP), systolic blood pressure (SBP), diastolic blood pressure (DBP), oxygen saturation (Sao2), skin temperature, arterial pulse, urine flow, capillary refill (CP) and level of conscious are among the hemodynamic indices and tissue perfusion parameters that are involved.

Face validity: The tool was tested by seven experts from Assiut University's critical care and emergency nursing school and medicine.

Tool Reliability:

The reliability was done on the developed tool by Cronbach alpha test and reliability level was (0.89).

Methods:

Preparatory phase:

Permission was initially obtained from the cardio thoracic intensive care unit management committee to enable the study to be conducted in the selected unit. Permission was not only granted to conduct the study,

but to assist with the recruitment of the participants. The ethical committees granted approval for the study to be conducted in the selected ICU.

Pilot study: The tool was tested on (10%=6) patients to see if it was feasible and applicable. Modifications were made as needed. The participants in the pilot study were not included in the study sample.

Ethical considerations: - The Faculty of Nursing's Ethical Committee had accepted a research proposal. During the application of the analysis, there was no risk to the study subjects. The study met standard clinical research ethics guidelines. After describing the essence and intent of the research, written consent was collected from patients or advices that were willing to participate in the study. Patients were told that the data of the study would be kept confidential. Patients were guaranteed confidentiality and anonymity, and they had the right to deny participation and/or withdraw from the study at any time for any reason.

Data collection: After obtaining the official approval, the intervention applied pre-operative and 1st, 3rd and 5th days post-operative in the intensive care unit (ICU).

The study conduction through 3 phases: assessment phase, Implementation phase & Evaluation phase:

Assessment phase:- The researcher assess patient using tool to assess demographic and clinical data It include demographic data (patient's code , age, sex, body mass index and past medical history), clinical data, tissue perfusion parameters such as : arterial pulse, level of conciseness, skin temperature, urine output, capillary refill, heart rate, respiratory rate, systolic blood pressure(SBP), diastolic blood pressure (DBP),mean arterial pressure(MAP),central venous pressure(CVP), and oxygen saturation(Sao_2).

Implementation phase: - Control group receive routine hospital care includes deep breathing and coughing exercise**.**

- Study group receive routine hospital care: deep breathing and coughing exercises, and exercise immediately after extubation are all recommended in the following steps:
- Place patient in comfort position, assess patient condition before and after exercise, measure vital signs before and after every session of exercise ,measure effort and exertion for patient.
- Muscle training with dumbbells for the upper limb (biceps and triceps) and shin pads for the lower limb (quadriceps) were performed with the patient in Fowler 45 during the immediate post-operative period, followed by sitting in bed with a free lower limb allowing alternated and unilateral knee extension. Exercise of the hip adductors and abductors, as well as the triceps, took place on the ward, where patient was free to ambulate, and consisted of three sets of 10 repetitions for each muscle group. Early exercises were performed after extubation for 30 minutes, twice a day in the (ICU).
- Before, during, and after practicing exercises, the researcher recorded heart and respiratory rates, as well as oxygen saturation. Blood pressure was assessed using a digital sphygmomanometer.
- During exercises in the ICU, heart and respiratory rates, and oxygen saturation, arterial pulse, level of conciseness, skin temperature, peripheral perfusion, urine output as indicator for renal perfusion , Capillary refill, blood pressure (BP) mmHg (systolic, diastolic, and mean arterial blood pressure), central venous pressure, and oxygen saturation were all measured before, during, and after the procedure.
- The researcher prepared brochure includes nursing activities as planned exercises photos and introduced to nurses staff and patients to complete nursing intervention post coronary artery bypass graft.

Evaluation phase:-

Data for this group was collected from 30 patients who met predetermined criteria in the control group who received routine hospital care using tools II and I. After the implementation phase, the researcher determine the effect of planned exercise on outcomes for a patient with percutaneous balloon valvuloplasty. The tissue perfusion parameters for intensive care post coronary bypass graft patients after implementing planned exercise using as previously mentioned **part (II)** done for both

Statistical analysis

Prior to statistical analysis, the data were tested for normality and homogeneity variances using the Anderson-Darling test. Continuous variables were defined by mean and standard deviation, while categorical variables were described by number and percent (N, percent) (Mean, SD). For comparing categorical and continuous variables, the chi-square test and the Fisher exact test are used.

Results

Table (1): Comparison between the patients in Study and control groups according to demographic data

Variable	Study(n=30)		Control(n=30)		P value
	No.	%	No.	%	
Age by year					
18- >35	7	23.3	9	30	0.184
35-> 60	10	33	9	30	
≥ 60	13	43.3	12	40	
Sex					
Male	15	50.0	18	60.0	0.436
Female	15	50.0	12	40.0	
BMI Level					
Normal weight	25	83.3	22	73.3	
Abnormal weight	5	16.7	8	26.7	
Past medical history					
Angina	4	13.3	0	0.0	0.100
DM	4	13.3	3	10.0	
Hypertension.	9	30.0	2	6.7	
Hypertension and DM	5	16.7	5	16.7	

BMI: body mass index, CABG: coronary artery by-pass graft

Chi-square test Statistically Significant difference at P. value <0.05

Table (2): Comparison between the patients in Study and control groups according to vital signs and urinary output.

Variable	Control	Study	P. value
	Mean±SD	Mean±SD	
Heart rate			
Pre-operative	87.9±11.44	86.76±9.53	0.679
Post-operative	86.8±9.36	85.17±7.67	0.469
3rd day	83.5±12.05	85.83±7.56	0.380
5th day	82.8±9.61	84.72±7.58	0.398
Respiratory rate			
Pre-operative	19.3±5.1	19.34±3.45	0.77
Post-operative	19.43±3.95	20±2.84	0.530
3rd day	21.1±3.75	20.48±2.85	0.481
5th day	19.87±3.06	20.45±2.21	0.408
Temperature			
Pre-operative	37.43±0.94	37.35±0.49	0.668
Post-operative	37.22±0.41	37.19±0.38	0.769
3rd day	37.1±0.31	37.17±0.31	0.392
5th day	37.05±0.27	37.07±0.26	0.785
Urinary output			
Pre-operative	768.33±561.63	868.97±434.13	0.446
Post-operative	625±409.95	767.24±366.27	0.166
3rd day	525±330.3	531.03±274.32	0.940
5th day	410±193.16	439.66±177.97	0.543
SBB			
Pre-operative	117.53±12.73	121.17±10.17	0.231
Post-operative	119.67±11.29	120.62±8.78	0.719
3rd day	115.67±12.23	120±8.45	0.120
5th day	119.17±7.08	124.83±9.49	0.012*
DBB			
Pre-operative	73.2±11.57	77.59±9.03	0.111
Post-operative	76.5±8.72	78.97±6.73	0.230
3rd day	74.67±8.5	79.31±4.58	0.012*
5th day	78.33±4.42	80±6.94	0.274

Independent t-test ** Significant difference at p. value <0.05*

SDD: systolic blood pressure DBB: diastolic blood pressure

Table (3): Comparison between the patients in Study and control groups according to tissue perfusion Parameters.

Variable	Control	Study	P. value
	Mean±SD	Mean±SD	
Capillary refill			
Pre-operative	1.34±0.85	1.79±0.4	0.21
Post-operative	2.34±0.85	1.79±0.4	0.002**
3rd day	2.34±0.85	1.78±0.4	0.002**
5th day	2.34±0.85	1.79±0.4	0.002**
Level of consciousness			
Pre-operative	13.87±0.35	13.9±0.31	0.728
Post-operative	13.87±0.35	13.9±0.31	0.728
3rd day	13.87±0.35	13.9±0.31	0.728
5th day	13.87±0.35	13.9±0.31	0.728
Skin Temperature			
Pre-operative	37.43±0.94	37.35±0.49	0.668
Post-operative	37.22±0.41	37.19±0.38	0.769
3rd day	37.1±0.31	37.17±0.31	0.392
5th day	37.05±0.27	37.07±0.26	0.785
Sao2			
Pre-operative	83.52±10.2	84.3±9.53	0.47
Post-operative	87.85±8.18	86.16±6.49	0.385
3rd day	85.03±9.52	86.59±7.23	0.483
5th day	85.36±7.5	84.45±8.36	0.661
MAP			
Pre-operative	87±8.98	88±8.95	0.71
Post-operative	89.7±7.76	92.76±5.93	0.095*
3rd day	88±8.62	92.45±4.69	0.017*
5th day	94.17±8.47	94.48±6.11	0.870
Peripheral pulse			
Pre-operative	120.19±32.47	123.35±7.28	0.630
Post-operative	126.15±4.56	123.23±4.79	0.027*
3rd day	126.85±5.02	124.08±4.65	0.048*
5th day	128.85±9.02	124.08±9.65	0.068*
CVP			
Pre-operative	9.15±2.35	9.45±1.62	0.17
Post-operative	9.1±1.94	9.76±1.02	0.110
3rd day	8.57±1.83	9.38±1.57	0.073
5th day	7.9±1.4	8.69±1.51	0.042*

*Independent t-test * Significant difference at p. value <0.05*
MAP: mean arterial pressure CVP: central venous pressure

Table (1): Presents the demographic profiles of the patient. More than half of both the research and control groups (56.3 percent and 60%, respectively) were between the ages of
20 and 60, with the majority being older adults. In terms of gender, half of the research groups (50 percent) and the control group (60 percent) were males.

Table (2): Shows a comparison of vital signs between patients in the study and control groups. During the time before the procedure until the fifth day, no statistically significant changes in heart rate, respiratory rate, or temperature are found between the two groups. After the surgery, there is a statistically significant disparity between the two groups in terms of DBP on the third day (p=0.012), and statistically significant variations in terms of SBB before and after the procedure on the third day (p=0.012).

Table (3): There are statistical discrepancies between the two groups in terms of capillary refill after the procedure and on the third and fifth days (p=0.002). In terms of MAP on post-operative and third

(p=0.095, 0.017), there was a statistical discrepancy between the two groups. However, there is a statistical significant in peripheral pulse between the two classes after surgery and on the third and fifth days (p=0.027, 0.048, 0.068).

Discussion

The coronary artery bypass graft (CABG) is one of the most popular procedures for ischemic heart disease patients who need coronary revascularization. However, hypoxemia can cause a number of complications after CABG, including pulmonary complications and arrhythmia. (**Mampuya, 2012)**

In the present study, no statistically significant differences were found between study and control groups as regards to arterial pulses, heart rate, level of consciousness, respiratory rate, skin temperature, urine output , but There are **Tiwari, & Verma, 2019** show that The major changes in the respiratory system as a result of endurance training are an increase in pulmonary ventilation as a result of increases in both tidal volume and respiration rate, and an increase in pulmonary diffusion at maximum work level primarily due to increases in pulmonary blood flow, particularly to the upper regions of the lungs, and changes in arterial pressure, heart rate.

The capillary refill notes that it returns to normal and is improving in the study group than in the control group. Several studies have investigated the increases, time of The capillary refill which coupled with a transient increase in systemic vascular resistance**, (Zobba et al., 2011).** In this study the planned exercise effect on SBP and DBP and showed the blood pressure increases in study group than control this result not confirm with other study (**Figueiredo et al., 2015).**

In the present study, showed no difference between two group in Sao2 but may be better in the study than the control groups. The researcher point of view, o2 therapy for post coronary artery bypass graft received the same level of oxygen and Physical activity can help wound healing by increasing tissue perfusion and oxygen delivery. For a long time, it has been recognised that oxygen plays an important role in the synthesis of connective tissue and wound infection resistance. **(Bentov, & Reed, 2015).**

It's crucial to know whether manipulating clinical therapies like physical activity can improve the balance between oxygen supply and demand in injured tissues where molecular oxygen is required for successful healing. **(Lobelo et al., 2018)** central venous pressure rise in the study group than in the control group. The sudden rise in CVP found at the start of exercise has been attributed to the activity of the muscle pump, but it is also influenced by reflex changes in cardiac response. This result backs up the previous findings. **(Möbius-Winkler, et al 2016).** Unlike regular subjects, the CVP of heart transplant patients continued to increase until the second and third minutes of exercise. **(Kondo, et al 2018).**

Increases the mean arterial blood pressure after resistance exercise in study group than control but several studies report the resistance exercise may be decreased mean blood pressure**. (Shimojo, et al 2018).**

The peripheral perfusion improved after operation when start the exercises program in study group than control confirm with **(Leeuwis, et al 2017)** (**Robinson, et al 2016).** was concluded that patient's in control group with open heart surgery were lacking the hemodynamic &tissue perfusion Parameters. Implementation of the planned exercises was associated with significant improvements of hemodynamic & tissue perfusion Parameters, while also assisting in improving respiratory rate. The researcher point of view exercises promote vascular network responsible for oxygen destitution from arteries to capillary so there better tissue perfusion.

Conclusion:

It can be concluded that the planned exercise had a significant improvement on capillary refill, mean arterial blood pressure and peripheral pulse of patients with open-heart surgery.

Recommendations are as follows:

The following recommendations are made based on the findings of this study:

1- Exercises for postoperative cardiac patients should be planned and offered on a regular basis.
2- Health education to the patients, their caregivers and health care professionals about importance and applying of post operative exercises.

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