Effect of Prehabilitation on Patient's Undergoing Coronary Artery Bypass Graft Outcomes

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Abstract:
Background: cardiac pre-training Prehab improves cardiac patients' physical fitness and considerably lowers their mortality rates. Little is known about the use of exercise therapy before coronary artery bypass graft (CABG) surgery in order to improve patients' physical fitness preoperatively. **This study aimed** to assess the effect of prehabilitation on patient's undergoing coronary artery bypass graft outcomes. **Research design:** Aquasi-experimental research approach was employed. **Subject:** sixty adult patients divided into 2 groups 30 patients in each having coronary artery bypass graft, one as study group, and the other as control group. Patient's age was between 18 and 65 years old. **Setting:** At cardiothoracic surgery department at Assiut University Heart Hospital. **Three following tools were** utilized for data collection: Patient's assessment sheet (Demographic patient data, Patient's medical data, General health assessment sheet), Assessment of physical activity and functional capacity for patient (Six minute walking test, Borg Rating of Perceived Exertion (RPE)), Construction Prehabilitation Nursing Booklet. **Result**: there was statistical significance difference between study and control groups as regarding general health regarding Physical function, pain, Physical performance and validity, highly statistical significance difference was found between study and control groups as regarding 6minuts walk test, statistical significance perceived regarding exertion scale. **Conclusion:** Post prehabilitation patient outcome improves regarding decrease hospital stay &early recovery than prehabilitation implementation. **Recommendations:** Prehabilitation application for all patients undergoing coronary artery bypass graft should be given in the form of video to be more effective.

Keywords: Prehabilitation, Coronary artery diseases & Coronary artery bypass graft surgery.

Introduction

During coronary artery bypass surgery (CABG), a blood vessel removed from another part of the body to restore blood flow beyond the artery's constricted section. In order to bypass the blocked coronary artery, one end of the blood vessel is grafted to it below the blockage or constriction and the other end is attached to the aorta, **(Zhen et al., 2021).**

Bypass graft is a surgical operation in which a blood vessel is grafted to the blocked coronary artery to allow blood to flow after the blockage area. Patients who have three- diseased vessel, with left ventricular ejection fractions (LVEF) > 3%, or severe disease in the left main corona artery are candidates for the CABG operation. Compared to medicinal therapy or percutaneous procedures like angioplasty or stents, surgical revascularization (CABG) has lower long-term morbidity and mortality rates, **(Goldstein et al., 2022).**

The degree of issues linked to CABG surgery can shed light on patients' and nurses' opinions regarding that leg and chest wounds, drugs, and complications were the most critical learning needs for the patients relative to other domains. Additionally, patients they might have been more eager to follow treatment plans and drug schedules due to their worries about wound infection and potential re-hospitalization, **(Al-Maskariet al., 2021).**

The main objective of cardiac rehabilitation (CR) is to help patients recover as quickly and completely as possible by enhancing their functional ability, emotional state, and overall sense of well-being. CR's secondary objectives include the management of risk factors, enhancement of the psychological status, and improvement of quality of life patients, **(Alfaraidhy et al., 2022).**

Prehabilitation (PREHAB) is defined as the process of improving the functional capacity of an individual before a surgical procedure in order to reduce potential complications and enhance surgical success, **(Carli et al., 2020).**

Cardiovascular rehabilitation is a safe and efficient method of treating patients who have experienced cardiac events (CR). The comprehensive, long-term programmes known as CR services include counseling, education, and modification of cardiac

risk factors, as well as medical evaluation, prescription exercise, and medical education. These programmes aim to control cardiac symptoms, slow or stop the atherosclerotic process, diminish the physical and psychological effects of heart disease on patients' quality of life, reduce the risk of sudden death or re-infarction, and enhance the psychosocial and occupational status of certain group of patients, **(Bozkurt et al., 2021)**.

Significance of the study

Patients who are waiting for coronary artery bypass graft (CABG) surgery frequently fear from being physically active, according to the researcher's two years of experience as the head nurse in the cardiothoracic department. However, during this waiting period, patients could engage in preoperative rehabilitation, which enhances the safety and effectiveness of their potential surgical intervention and promotes continued participation in postoperative rehabilitation.

The aims of this study were:
To assess the effect of pre rehabilitation on patient's undergoing coronary artery bypass graft outcomes through:

- Assessing patient's physical activity and functional capacity.
- Designing and implementing prehabilitation on the patient undergoing coronary artery bypass graft based on their assessed needs.
- Evaluate the effect of implementing prehabilitation on the physical activity and functional capacity on the patient undergoing coronary artery bypass graft.

Patients and Method:

Technical design
Quazi experimental design was utilized in this study.
Setting:
This study was carried out in the cardiothoracic surgery department at Assiut university heart hospital.
Sample:
Adult patients (60) undergoing coronary artery bypass graft, divided into 2 groups (control and study) 30 patients in each group. Patient ages between 18 and 65 years old.
Sample size:
60 patients according to Steven K, the following equation were used to select the sample size. Thompson (2012):

$$n = \frac{N \times p(1-p)}{\left[\left[N-1 \times \left(d^2 \div z^2\right)\right] + p(1-p)\right]}$$

N=total patient population size was 159 who attended in cardiothoracic department of Assiut university hospitals in 2020 (taking from the statistical of the

cardiothoracic surgery department at Assiut university heart hospital report).
Sample was taking during year 2021 through 6 month.
Z = confidence levels is 0.95 and is equal to 1.96
D= the error ratio is = 0.05
P= the property availability ratio and neutral = 0.50.
From the research sample 20 patients were excluded, as they were died after surgery so anther 20 patient were added to the study with the same criteria. The patients included were randomly assigned into 2 equal groups each one composed of 30 patients: group 1(study group): were exposed to the educational nursing protocol beside the routine hospital care and group 2 (control group) was exposed to the routine hospital care only. Patients revised the prehabilitation after end of the research. Every patient was given copy of the booklet before discharge.

Tools for data collection
Three tools were used for data collection to achieve the study purpose.
Tool (1): Patient's assessment sheet questionnaire:
It was developed by the researcher based on Current national and international literatures it includes three parts:
Part 1: Patient's Demographic data: this part was including Patient's name, age, gender, marital status, level of education and occupation.
Part 2: Patient's medical data: This part aimed to assess of the following: Risk factors included (hypertension, diabetes, smoking, impaired renal function, impaired liver function, idiopathic pulmonary fibrosis (IPf), obstructive pulmonary disease (CoPD), and obesity developed by **(Tomisaki et al.,2023)** was body mass index (BMI) was calculated by dividing the patients' mass in kilograms by the square height in meters (BMI = kg/m2),Major adult BMI classifications are underweight (under 18.5 kg/m2), normal weight (18.5 to 24.9), overweight (25 to 29.9), and obese (30 or more)
Part 3: - Patient's General health assessment Checklist developed by (**Rancic et al., 2020**):It is compared between two group postoperatively regarding(Blood pressure, Heart rate, Saturation, intensive care units (Icu) length of stay, Length of hospital staying, Physical function, Pain, Physical performance and Validity). Physical function by used (Depended on his self, Independent on his self); Pain by used pain scale, Physical performance (Light, moderate and heavy) according to perform of patient after surgery and Validity (Energy or tired).
Scoring system for pain scale:
The pain scale has 10 items which utilized in this (0) no pain, (1-3) mild pain, (4-6) Moderate pain, (7-10) severe pain

Tool (2): Assessment of physical activity and functional capacity for patient: included two parts:

Part 1: Six minute walking test **(Du et al., 2009)**: submaximal effort evaluation capacity to perform the daily living activities, that assessment of symptoms and functional capacity for exercise, through Place cones at either end of the 30 meter stretch as turning points. It has been used to measure the level of functional capacity for exercise through walking patient for six minute, observe patient and record: Nothing at all dyspnea, very-very slight dyspnea, Slight dyspnea, Moderate dyspnea ,Somewhat severe dyspnea ,Severe dyspnea.

Part 2: The Borg Rating of Perceived Exertion (RPE) scale **(Pageaux, 2016)**, it has been used to measure the level of physical strain or perceived exertion. The Borg include 15-point RPE scale a rating of 6 was to be associated with no exertion, i.e. rest, and a rating of 20 with maximal exertion, i.e. the most stressful exercise performed.

Scoring system for Borg Rating of Perceived Exertion (RPE) scale:

Score	Level of exertion
6-7	No exertion at all
7.5- 8	Extremely light
9-10	Very light
11-12	Light
13-14	Somewhat hard
15-16	Hard(heavy)
17-18	Very hard
19	Extremely hard
20	Maximal exertion

- 9 = 'very light' exercise which equals walking slowly for few minutes at own pace of a healthy individual.
- 13 = 'somewhat hard' but the individual is still able to continue the activity.
- 17 = 'very hard'. A healthy person can continue but must push themselves beyond their comfort of being very fatigued.
- 19 = extremely strenuous exercise. For most people, the hardest they have ever experienced.

Operational design

This study was carried out in two phases:

Phase I: Preparatory phase

In this part the researcher reviewed the current, past, local and international related literature from the various aspects using books, articles, periodicals and magazines. The proposed study settings were assessed for number of patients admitted to cardiothoracic surgery department who undergoing coronary artery bypass graft surgery. During this phase tools of data collection were prepared.

Tools Validity and Reliability:

Validity; content of data collection tools were reviewed by five experts for clarity, relevance, comprehensiveness, understanding, applicability, and ease of use by the nurses. Minor modifications were needed, and correction was carried out in accordance. The content validity was performed by two medical staff members from the cardiothoracic surgery department and three nurses from the medical surgical nursing department. In terms of reliability, the tools' consistency was verified statistically by using the Cronbach's alpha value (alpha=0.829).

Administrative design

A letter was issued from the faculty of nursing at Assiut University to the head of cardiothoracic surgery department at Assiut University hospital, explaining the purpose of the study and requesting their permission for collecting the data.

Ethical and legal consideration

- Research proposal was approved from the Ethical Committee of the Faculty of Nursing, Assiut University.
- There was no risk for the study subjects during the research application.
- The study is following the common ethical principles of the clinical research.
- Written consent was being obtained from patients who were participating in the study, after explaining the nature and purpose of the study.
- Confidentiality and anonymity were assured.
- Study subjects have the right to refused to participate and or to withdraw from the study without any rational and at any time.
- Study subject privacy was considered during data collection.

Pilot study

The Pilot study was conducted on six patients who were hospitalized in the cardiothoracic surgery department, representing 10% of the study sample, to assess the viability and clarity of the tools. This pilot investigation indicates that the necessary adjustments were made. The aim of the pilot study was to test tool's applicability, identify any issues that would hinder the data gathering process, and calculate the time required to fill in the study tools.

Construction Prehabilitation Nursing Booklet:

It constructed by the researcher. It was developed based on patients identified needs post the pre assessment pre the operation and as well on reviewing the national and international references including the content of the best practice statement for CABG surgery, it was applied by researcher, it covered the system and consist of the following.

- Introduction to open heart surgery (coronary artery bypass graft surgery).

- Characteristics of the patients who will be undergo such operation.
- Pre-operative examinations and patients' preparation at the night of the operation.
- Exercises that must be maintained before and after the operation to improve the respiratory functions (Use of a spirometer, coughing exercises, correct way to cough after surgery).
- Patients' preparation during operation (Explanation of the process from entering the operating room to entering the intensive care unit).
- Patients' preparation after the operation, Care of the surgical site.
- Complications following open heart surgery (coronary artery bypass graft surgery) including (bleeding, infection, reactions to anesthesia, damage to tissues in the heart, kidneys, liver, and lungs, stroke, and death).
- How to avoid complications after the operation (Wound care, Leg clot prevention tips, and wear compression stockings first thing in the morning. That's when your leg is usually least swollen. Wear your stockings every day .smooth the compression stocking as pull it on, so that there are no bunches or kinks. Also, check that the seams of the stocking run straight up your legs. Instruct patient Check legs every day for redness, irritations, or other skin issues. These could be signs of an infection or a poorly fitted stocking.), sleep and Walking.
- Patients eating batter post open-heart surgery.

Phase II: implementation phase

- Data were assessed from Assiut University's cardiothoracic surgery department hospital, during the period from June 2021 to March 2022. The tools were filled through interviewing the study subjects after explaining the purpose of the study to all patients prior to data collection. The study was carried out during morning and afternoon shifts for all available patients.
- Once granted permission to move forward with the proposed study, the research proposal was presented to the Assiut University Hospital research committee. Names of potential patients who had been admitted to the unit and who met the requirements of the study were collected daily from the hospital's nurses and doctors in the cardiothoracic surgery department.
- The researcher fills in the patient's preoperative structured assessment instruments for the control group after receiving their oral consent for voluntary participation in the study, Each patient

was assessed twice pre and post the operation Reassessing the patient's status, considering any difficulties, the patient says, or felt while discharged from the intensive care unit.

- Preoperatively for the study group, after the patient has completed the structured assessment tools, the researcher evaluates the patient's practice and knowledge levels about the coronary artery bypass graft surgery before explaining to the patient the prehabilitation nursing booklet that the researcher has been developed based on patient's identified needs after analyzing the data collected during the pre-operative assessment.
- The prehabilitation nursing booklet guide was written in straightforward Arabic and contains comprehensive information about CABG surgery (overview about anatomy and functions of the heart, pre - post care and follow up instructions about CABG surgery). It was explained to the patient over two sessions, each lasting roughly about 45 minutes and including 15 minutes for questions and answers. However, depending on the patient's educational background and comprehension capacity, the length of each session may vary according to the needs of each group.
- The prehabilitation nursing booklet was distributed to every patient in the study group. Patients were assessed for practice as soon as possible after CABG surgery and continued until discharge from hospital.

Statistical design

Data analysis was done using the statistics Package for (SPSS) version (23) programmer. The quantitative data in every questionnaire as well as the demographic data was analyses using descriptive statistics. Included in descriptive statistics were frequencies and percentages. Use the Pearson chi-square test (cross tabulation) to compare patient knowledge before and after the training. Independent t-test, one-way anova, and Pearson Correlation were utilized (Correlation is significant at the 0.05 level). The study's level of significance was established at (p 0.05) to identify any indications of differences in the available data.

Results

Table (1): Comparison between study and control group regarding patients demographic data (n=60)

Variables	Study		Control	
	N	%	N	%
Age				
30 –to less than 40yrs	0	0.0	1	3.3
40 – to less than 50yrs	5	16.7	6	20.0
50 –to less than 60 yrs	**13**	**43.3**	**14**	**46.7**
60 –to less 65 yrs	12	40.0	9	30.0
Gender				
Male	**23**	**76.7**	**25**	**83.3**
Female	7	23.3	5	16.7
Marital status				
Married	**29**	**96.7**	**25**	**83.3**
Divorce	0	0.0	2	6.7
Widow	1	3.3	2	6.7
Separated	0	0.0	1	3.3
Education level				
Illiterate	13	43.3	13	43.3
read and write	**15**	**50.0**	**15**	**50.0**
University	2	6.7	2	6.7
Occupation				
office work	**13**	**43.3**	**14**	**46.7**
Farmer	4	13.3	3	10.0
machinery work	2	6.7	3	10.0
house wife	4	13.3	2	6.7
not working	7	23.4	8	26.6

Chi-Square Tests *=Significant difference*p≤0.05.   **=highly significance, *p≤0.01 Ns= Non significant difference.

Table (2): Comparison between study and control group regarding medical data (n=60)

Variables	Study		Control		X2	Sign.
	N	%	N	%		
Smoking					.659	.589
Yes	**21**	**70.0**	**18**	**60.0**		
No	9	30.0	12	40.0		
Type of smoking						
Cigarette	**19**	**36.3**	**15**	**50.0**	6.748	.150
Shisha	1	3.3	1	3.3		
both 1-2	0	0	2	6.7		
Another addict	0	0	0	0		
Smoking number per\day	12.90±12.69		8.0333±9.43		T: 1.685	.097
Number of cigarette	1.06±2.75		8.16±11.14		T :-3.387	**.001****
Hypertension	11	36.7	10	33.3	.635	.298
Diabetes	12	40.0	11	36.7	.267	.398
Impaired liver function	6	20.0	7	23.3	.800	.276
Impaired renal function	0	0.0	5	16.7	5.455	.052
Obstructive pulmonary disease (CoPD)	1	3.3	2	6.7	.351	1.000

Chi-Square Tests *=Significant difference, *p≤0.05 **= highly significance, *p≤0.01 Ns=Non significant difference

Table (3): Comparison between study and control group regarding body mass index   (n=60)

Variables	Study		Control		X2	Sign.
	N	%	N	%		
18.5-24.9 normal weight range	3	10	5	16.7	3.491	.175
25-29.9 overweight range	**22**	**73.3**	**15**	**50**		
30 and up obese range	5	16.7	10	33.3		
Body mass index	28.02±2.91		29.13±4.79		7.256	.282

*Chi-Square Tests *=Significant difference, *p≤0.05 **=highly significance, *p≤0.01   Ns=Non significant difference*

Table (4): Comparison between study and control group regarding General health (n=60)

Variables	Study		Control		X2	Sign.
	n	%	N	%		
Physical function						
Depended on his self	30	100.0	2	6.7	52.500	.000
Independent on his self	0	0.0	28	93.3		
Pain						
Moderate pain	19	96.7	11	36.7	24.300	.000
Severe pain	1	3.3	19	63.3		
Physical performance						
Light	2	6.7	18	60.0	29.843	.000
Moderate	11	36.7	12	40.0		
Heavy	17	56.6	0	0.0		
Validity						
Energy	29	96.7	6	20.0	36.274	.000
Heavy	1	3.3	24	80.0		

*Chi-Square Tests *=Significant difference, *p≤0.05 **=highly significance, *p≤0.01 Ns=Non significant difference.*

Table (5): Comparison between study and control group regarding 6minuts walk test (n=60)

Variables	Study		Control		X2	Sign.
	n	%	n	%		
nothing at all dyspnea	10	33.3	2	6.7		
Very ,very slight dyspnea	11	36.7	5	16.7	17.288	.004**
slight dyspnea	7	23.3	9	30.0		
moderate dyspnea	2	6.7	9	30.0		
somewhat sever dyspnea	0	0.0	3	10.0		
sever dyspnea	0	0.0	2	6.7		

*Chi-Square Tests *=Significant difference, *p≤0.05. **=highly significance*p≤0.01   Ns=Non significant difference*

Table (6): Comparison between study and control group regarding Borg rating of perceived extension   n=60

Variables	Study		Control		X2	Sign.
	n	%	N	%		
Level of extension						
extremely light	0	0.0	5	16.7	41.571	.000**
very light	3	10.0	9	30.0		
Light	0	0.0	13	43.3		
sometime what hard	11	36.7	3	10.0		
Hard	8	26.7	0	0.0		
very hard	8	26.6	0	0.0		

*Chi-Square Tests *=Significant difference, *p≤0.05. **=highly significance*p≤0.01 Ns=Non significant difference*

Table (1): Clarified that more than one third of the study patients and control **(43.3%. 46.7% respectively)** their age ranged from 50 to less than 60 yrs. old. There are more than two third in the study group and the majority in the control group **(76.7%, 83.3% respectively)** were male. The vast majority of both groups **(96.7%, 83.3% respectively)** were married. Half of both groups (**50.0%**) were read and write. More than one third of both groups **(43.3%, 46.7% respectively)** were office work.

Table (2): Showed that the majority of the study patients were Smoking **(70.0%)** and half of patients in the control were Smoking **(60.0%).** And one third among the study and control patients **(36.3%, 50% respectively)** is Cigarette smokers. Also there were no statistical significance difference between the study and control groups regarding number of cigarettes smoked per\day. With no statistical significance difference between study and control groups regarding Number of cigarettes smoked per\day. As well no statistical significance difference between study and control groups regarding Hypertension, Diabetes, Impaired liver function, Impaired renal function, and obstructive pulmonary disease (CoPD).

Table (3): Showed that the more than two third of the study patients were overweight **(73.3%)** and half of the control group were overweight **(50%),** with no statistical significance difference between study and control groups regarding body mass index.

Table (4): Clarifies that there was statistical significance difference between the study and control groups regarding the general health in relation to Physical function, pain, Physical performance, and Validity.

Table (5): Showed that there was highly statistical significance difference between study and control groups regarding 6minuts walk test.

Table (6): Clarified that there was statistical significance difference between study and control groups regarding Borg rating of perceived exertion scale.

Discussion

Prehabilitation improves physical preparedness for surgery, decreases postoperative problems and length of hospital stay, as well facilitates patients transfer from the hospital to the community, allowing patients to better endure the stress of surgery. Despite the little available evidence, a cardiac prehabilitation should incorporate education, dietary optimization, training exercise, social support, and anxiety reduction, **(Pokhrel & Mellor., 2021).**

Results of several studies show that cardiac rehabilitation after CABG-surgery is effective to increase exercise capacity, improve quality of life and reduce mortality, **(Galih& Martini., 2022).**

Regarding General health there were statistical significance difference between study and control groups regarding the Physical function, pain, Physical performance and validity. These findings agree with **Pačarić., et al (2020)** who mentioned that there was a significant difference between the study and control group after the rehabilitation. This finding supported **Nafady., et al (2019)** who emphasized that patients underwent early rehabilitation and early mobilization by physiotherapists, as well who demonstrate deep breathing, coughing, and walking exercises prior the operation in order to ensure adequate oxygenation, get read of mucus secretion, prevention of respiratory tract infection, and improved endurance and physical functioning. All such future issues are avoided by early rehabilitation.

Researcher's opinion that providing rehabilitation helped the patient reduce the patient's stay in the hospital, which helped reduce the patient's chance of diminishing hospital infections.

Regarding physical activity and functional capacity (6 Minute Walk Test) there was highly statistical significance difference between study and control groups regarding 6minuts walk test. These findings agree with **Steinmetz., et al (2020) who** mentioned that postoperative exercise which based on cardiac rehabilitation showed significant improvement as six-minute walk distance among patients. These findings agree with **Waite., et al (2017)** who noticed significant means difference during 6MWT distance. This finding supported by **Dharmapriya., et al (2019)** who mentioned that there was an improvement of 6-minute walk test after cardiac rehabilitation among obese and non-obese groups.

Regarding physical activity and functional capacity (Borg rating of perceived exertion) showed statistical significance difference between study and control groups regarding Borg rating of perceived exertion scale. This finding agreed **Nagm Eldean, et al (2019)** who found that the perceived exertion level during the same resistance exercise was significantly higher. This finding supported by **Dharmapriya., et al (2019)** who mentioned that there was an improvement on Borg scale after cardiac rehabilitation among obese and non-obese groups.

The researcher's opinion is that the patient's perioperative rehabilitation preventing postoperative complications.

There are several limitations on this study. The sample size is the trial's primary shortcoming. To ensure that it is effective on the patient, further samples are required. Another drawback was that we were unable to enroll individuals who were scheduled

for additional procedures (such as heart valve repair or replacement surgery).

In conclusion, our study shows that exercise Prehab is a viable option for individuals awaiting elective CABG surgery to improve their health status. Importantly, none of the Prehab patients experienced any cardiac side effects. To prove the safety and effectiveness of this strategy, a bigger sample size is needed.

Conclusion

Prehabilitation implementations improve patient's outcome with decrease hospital stay and early recovery.

Recommendations

On the basis of the study's findings, the following recommendations are suggested:

For patients

Prehabilitation Nursing Booklet should be given for patients in the form of video to be more effective.

For administration

To give coronary artery bypass graft patients the knowledge that they require, a written educational handbook should be available for each patient in plain language and with easy illustrations.

For research

To generate more generalizable data, a replication of the study with a bigger probability sample drawn from other Egyptian regions is advised.

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