Six Minute Walk Distance After Coronary Artery Bypass Graft Surgery: Comparative Study

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Abstract:

Background: *The 6-min walking test (6MWT) is a simple test, which does not require expensive equipment or advanced training. It has been used in heart failure patients to assess exercise tolerance, the effects of therapy and prognosis. Accordingly, post-surgical cardiac rehabilitation may be a potential field of application of this test*

Objective(s): *To identify tolerance of the exercise through Comparing six minutes walking and hemodynamic measurements (oxygen saturation(saO2),heart rate (HR)preoperative and at pre discharge from hospital between study and control groups and to identify brog scale rate for evaluation exertion associated with six minute waking given activity*

Methodology: *A Qusi-experimental design, A non-probability (purposive) samples of (60) patients with coronary artery bypass graft : (30) patients in the study group are exposed to the preoperative pulmonary training instructions and the control group consists of (30) patients who are not exposed to the preoperative pulmonary training instructions. The preoperative pulmonary training instructions and instruments are constructed and developed by the researcher to measure the purpose of the study. The measurement of training instructions through the use of six minute walking test 6MWT ; perceived exertion by Brog scale and Pulmonary Function Test Were performed preoperatively and at discharge.*

Results: *Sixty patients, the highest percentage is 21 (70%) of the patients are male in the study group and 22(73.3%) of the patients are male in the control group. The mean age for the study group is (59.0) and the mean age for control group is(58.6) were assessed. The results of the our study shows that there are significant differences between the study and control groups in postoperative for total distance walked in 6 minutes and Borg scale rating of perceived related to dyspnea ; fatigue*

Recommendations: *The study recommend that the Pamphlets and manuals should be described to orient patients about the preoperative pulmonary training and instruction to prevent postoperative pulmonary complication.*

Conclusion: *The study concludes that short-term preoperative pulmonary training instructions for patients undergoing coronary artery bypass result in clinically significant positive changes associated with improvement in tolerance of exercise after CABG.*

Keywords: *six minute walking , Distance, CABG, Surgery*

I. Introduction

Cardiac surgery is a well-established procedure worldwide due to its safety and effectiveness in treating cardiac patients. Among cardiac surgery, we highlight the CABG and valvar replacement [1]The 6-min walking test (6MWT) was first used by pneumologists to evaluate patients with lung diseases such as chronic obstructive pulmonary disease and respiratory failure and then by cardiologists for evaluating the functional limitation[2], the effects of the therapy and prognostic stratification of patients with chronic heart failure To perform the test, patients are instructed to walk as far as possible in six minutes and this maxim distance walked reflects his physical ability Recently, the ability or inability to perform the 6MWT in patients undergoing cardiac surgery in pre-hospital discharge was used as a predictor of risk of postoperative complications and mortality (3). The objective of the study was to identify tolerance of the exercise through Comparing six minutes walking and hemodynamic measurements (oxygen saturation(saO2),heart rate (HR) preoperative and at pre discharge from hospital between study and control groups and to identify brog scale rate for evaluation exertion associated with six minute waking given activity

II. Methods

A Quantitative, A Qusi-experimental design, was conducted in the study has been conducted at Iraqi Center of Heart Diseases . Formal agreement was obtained from the ministry of health and reviewed and

approved y "special committee" at University of Baghdad. Approval checking with Medical Director). A non-probability (purposive) samples of (60) patients with coronary artery bypass graft : (30) patients in the study group are exposed to the preoperative pulmonary training instructions and the control group consists of (30) patients who are not exposed to the preoperative pulmonary training instructions. Inclusion criteria are(1) The patients who are definitely diagnosed as having CAD for at least one year and above. (2) The adult patients male and female whom are between 40 to 70 years age (3) Patients with isolated CABG (4) The patients who have been attending the hospital for treatment and follow up (5) The patients who have agreed to participate in the study. The exclusion criteria consisted o(1)Those who are preoperative presenting arrhythmias(2)Patients who have history of musculoskeletal conditions (3)Patients who have an emergency operation (4)Patients who have previous cardiac surgery (5)Patients who have severe renal dysfunction requiring dialysis (6)patients who have difficulties in cooperating during measurements(7) Patients who have unstable angina(8) Patients who have psychiatric problems. (9) patients who have Chronic Obstructive Pulmonary Disease (COPD) and ,recent myocardial infarction(10) Patients who have complications in the postoperative period, reoperations. Patients in the study and control groups were evaluated in two periods of time: the pre and postoperative period .

Intervention: pulmonary training instructions for the study group consisted of The Breathing exercises ,flow-IS-based incentive spirometer (Respiflow™ FS) , effective coughing ,neck and shoulder mobilization exercises , aerobic exercises e.g six minutes walking and strengthen muscles

III. Measurements
The six minute walking test 6MWT is a submaximal test that measures the distance the patient can quickly walk on a flat surface in a period of 6 minutes During the test, the patient walks the longest possible distance within the time of 6 minutes on a flat surface and can stop or slow down at any time and then resume walking during the test. The test was symptom-limited, 6o patients who became symptomatic (e.g. severe dyspnoea, dizziness and musculoskeletal or angina, pain) were told to stop walking and restart when possible. Encouragement was not given. The total distance walked was measured to the nearest meter and recorded. Before the test, the patient's resting heart rate and oxygen saturation immediately after completion of the 6MWT, reseacher measured peak exercise data, including heart rate, oxygen saturation, rating of perceived exertion measurement by Brog scale (evaluation and exercise program. The questionnaire of Brog scale is modified by the investigator to suit to help the Iraqi population and integrate into 4 items .The scale has one statement and measured by liker rating scale very light , fairly light ,hard ,very hard the rating is scored as 1.2.3. and 4 respectively. The total score of statement have (1-4) scale is performed immediately after six minutes walking pre and at discharge for the study and control groups

Assessment of pulmonary function:
Pulmonary function was characterized by spirometry using a portable spirometer , the equipment is calibrated every morning prior to measurements first measurement preoperative and other predischareg from hospital. The patients are in a sitting position and a nose clip is used. Predicted values for pulmonary function are related to age, sex, length and weight according to the values .Pulmonary function test parameters include forced expiratory volume in 1 second (predicted FEV1), predicted forced vital capacity (FVC), percentage to FEV1 and FVC and predicted peak flow and peak expiratory flow (PEF). Pulmonary function test is carried out for both group

Data collected from the patient's records:
Age, gender, body mass index, medical history , preoperative left ventricular ejection fraction (LVEF), days of hospitalization in the intensive care unit (ICU), length of hospitalization, duration of mechanical ventilation (MV) , (forced vital capacity (FVC), forced expiratory volume in one second (FEV1)

Data Analysis:
Data were analyzed through the application of statistical procedures and using the package of SPSS version (22).Statistical procedures are description statistic (frequency ,percentage and cumulative percent ,arithmetic mean and standard deviations) and Inferential statistical (T test 'Chi-square) to present the differences between the study and control groups.

IV. Results

Table (1):characteristic of Socio-Demographic Characteristic of Study Sample for both Study and Control Groups

Socio-Demographic Characteristic		Study group		Control group		C.S
		No.	%	No.	%	P= 0.757
Age (years)	45-49	1	3.3	3	10.0	N.S.(Chi-sq)
	50-54	7	23.3	8	26.7	
	55-59	7	23.3	4	13.3	
	60-56	6	20.0	6	20.0	
	>65	9	30.0	9	30.0	
Total		30	100%	30	100%	
$\bar{X}_{\pm SD}$		59.0±6.8		58.6±6.6		
Gender	Male	21	70.0	22	73.3	P=0.774
	Femal	9	30.0	8	26.7	N.S. (Chi-sq.)
Total		30	100%	30	100%	
Smoking status	Previous smoker	13	43.3	16	53.3	P =0.438
	Not smoker	17	56.7	14	46.7	N.S(Chi-sq.)
Total		30	100%	30	100%	
BMI (Kg/m2)	Normal (18.5-24.9)	5	16.7	6	20.0	P= 0.937
	Overweight (25-29.9)	13	43.3	12	40.0	N.S. (Chi-sq.) (Chi-square test)
	Obese (=>30)	12	40.0	12	40.0	
Total		30	100%	30	100%	
$\bar{X}_{\pm SD}$		29.1±4.4		28.9±4.5		

≥= more than; No .= number , %= percentage , C.S= comparative significant; p= p value 0.05; N.S= no significant; BMI (Kg/m2)= body mass index (kilogram on meter square)Variable presented ; (Chi-sq.)= (Chi-square test); $\bar{X}$ = mean; SD= Standard deviation

Table (1) shows Statistically, there is non significant differences at p=≤ 0.05 between the study and control groups related to the gender, age, smoking statues body mass index when analyzed by Chi-square test.

Table (2): The Clinical Characteristic of the Study Sample for Both Study and Control Groups.

Clinical Characteristic			Study group		Control group		C.S
			No.	%	No.	%	
Medical History	**Ischemic heart disease(M.I)**	Yes	26	86.7	28	93.3	P = 0.211
		No	4	85.3%	2	2.7	**N.S**; (Chi-sq.)
		Total	30	100%	30	100%	
	Hypertension	Yes	26	86.7	21	70.0	P = 0.117
		No	4	13.3	9	30.0	**N.S**; (Chi-sq.)
	Diabetes	Yes	21	70.0	25	83.3	P = 0.222
		No	9	30.0	5	16.7	**N.S.**(Chi-sq.)
	Respiratory tract infection	Yes	7	23.3	9	30.0	P = 0.559
		No	23	76.7	21	70.0	**N.S.** (Chi-sq.)
Surgical Histor		No	21	70.0	22	73.3	P = 0.566
		Yes	9	30.0	8	26.7	**N.S.**(Chi-sq.)
		Total	30	100%	30	100%	
Preoperative Left Ventricular Ejection Fraction (LVEF),		<40%	1	3.3	3	10.0	P = 0.580
		40--59%	21	70.0	20	66.7	**N.S.** (Chi-sq.)
		=>60%	8	26.7	7	23.3	
		Total	30	100.0%	30	100.0%	
NeYork Heart (Association NYHA)		Class I	-	-	-	-	P = 0.766
	Class II		8	26.7	7	23.3	**N.S**. (Chi-sq.)
	Class III		22	73.3	23	76.7	
Total			30	100%	30	100%	

No .= number ;%= percentage ; C.S= comparative significant;(NYHA)= New York Heart Association(classify patient heart failure); p= p value 0.05; N.S= no significant; (Chi-sq.)=Chi-square

Table (2) shows that there is Statistically   is no significant differences between the study and control groups related to clinical Characteristic   such as medical ; surgical history , Preoperative Left Ventricular Ejection Fraction (LVEF), and classify patient heart failure New York Heart Association NYHA when analyzed by Chi-square test.

Table (3): The Comparison of Postoperative Complications of 60 Patients Undergoing (CABG) in the Intensive Care Unit Between Study and Control Groups.

ICU Characteristic		Study group		Control group		C.S
		No.	%	No .	%	
Days of Hospitalization in the Intensive Care Unit (ICU)	<24	2	6.7	-	-	P=0.005 S(Chi-sq.)
	24	26	86.7	18	60.0	
	=>48	2	6.7	12	40.0	
	Total	30	100%	30	100%	
$\overline{X} \pm \textbf{SD}$			36.9±7.7		45.0±6.5	
	Total	30	100%	30	100%	
ventilator hours	<5	17	56.7	6	20.0	P=0.005* S(Chi-sq.)
	5—9	13	43.3	20	66.7	
	=>10	-	-	4	13.3	
	Total	30	100%	30	100%	

ICU = intensive care unite ; No .= number , %= percentage , C.S= comparative significant;S= significant; = mean; SD= Standard deviation ;(Chi-sq.)=Chi-square test.

Table (3) shows that there is significant difference related to the days of hospitalization in the intensive care unit , ventilator hours between study and control groups when analyzed by Chi-square test.

Table (4) TheCompression of Pulmonary Function Test Between Study and Control Groups in Per and Postoperative

Pulmonary function test PFT	Preoperative				P valve between study and control group pre-op	Postoperative				C.S between study and control group post-op
	Study group		Control group			Study group		Control group		
	$\overline{X}$	SD	$\overline{X}$	SD		$\overline{X}$	SD	$\overline{X}$	SD	
(FVC%)	81.8	9.1	80.0	13.3	0.535	60.2	12.0	53.8	11.0	0.036# S(t-test)
FEV$_1$%	88.1	7.6	85.3	12.8	0.306	63.0	12.3	59.3	8.6	0.179
FVC/FEV$_1$	92.0	7.5	88.3	8.4	0.077 S(t-test)	81.3	9.8	74.5	11.8	0.018 S(t-test)
(PEF%) (L/min)	78.	16.4	70.8	17.6	0.084 S(t-test)	57.5	16.6	39.2	16.1	0.0001 S(t-test)

PFT= pulmonary function test ,No .= number , FVC: forced vital capacity; FEV1: forced expiratory volume in 1 s; C.S= comparative significant ; S= significant ;(t-test)=Student's t test; (L/min)= liter per minute pre-op= preoperative, post-op= postoperative; = mean; SD= Standard deviation

Its appears from table (4) that there is significant differences between the study and control groups in postoperative of pulmonary function test such as the force vital capacity , percentage for force vital capacity at force expiratory volume in one second and peak expiratory flow when analyzed by t- test
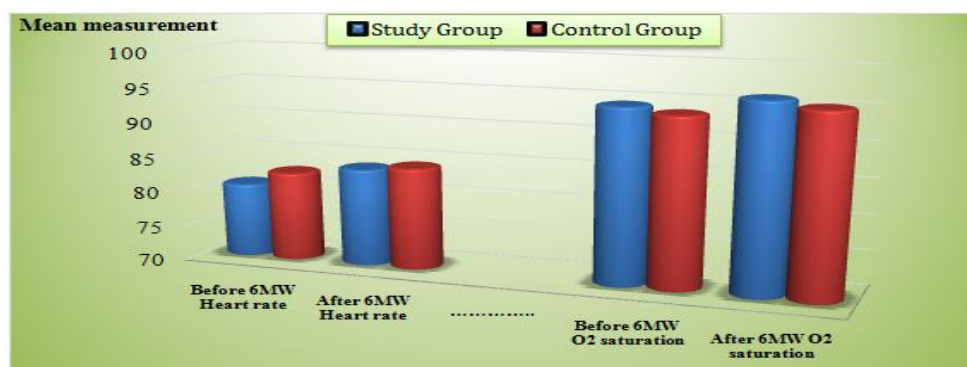

Figure (1) TheCompression of Six Minute Walking related to Heart Rate and saO2 at Preoperative period Between Study and Control Group

This figure presents condition of heart rate and saO2 for 60 patient undergoing CABG surgery during six minute walking preoperative to the mean measurement ,the increase mean of saO2 for study group aftersix minute walking .
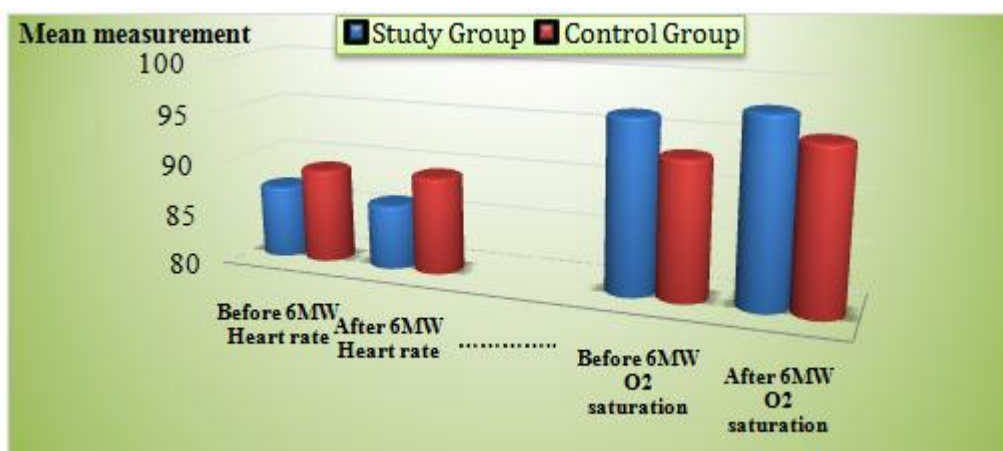

Figure (2) TheCompression of Six Minute Walking related to Heart Rate and saO2 at postoperative period Between Study and Control Group

This figure presents condition of heart rate and saO2 for 60 patient undergoing CABG surgery during six minute walking posteoperative to the mean measurement ,the increase mean of saO2 for study group after six minutewalking .

Table (5) TheCompression between Study and Control Group for Six MinutesWalking,Dyspnea ;Fatigue; Stopped and Total distance in preoperative period
Variable presented as mean ± Standard deviation or as absolute frequency (relative frequency):[1]: Student's t test; [2]: Chi-square continuity correction test; m= meter

Variable		Study group		Control group		C.S
		No	%	No	%	P =0.007
Dyspnea (Brog scale)	Light	19	63.3	7	23.3	
	Fairly light	8	26.7	18	60.0	S
	Hard	3	10.0	5	16.7	
Fatigue (Brog scale)	Light	18	60.0	6	20.0	P=0.005
	Fairly light	9	30.0	15	50.0	S
	Hard	3	10.0	9	30.0	
Stopped or paused before 6 minutes	Yes	6	20.0	16	53.3	P =0.007
	No	24	80.0	14	46.7	S
Reason (before)	Pain	3	50.0	-	-	P =0.007
	Dizziness	3	50.0	8	50.0	S
	Dyspnea	-	-	6	37.5	
	Angina	-	-	2	12.5	
Total distance walked in 6 minutes/m pre-operative	50---	2	6.7	14	46.7	P =0.001
	100---	7	23.3	7	23.3	S
	150---	10	33.3	7	23.3	
	=>200	11	36.7	2	6.7	

It appears from table (5) that there is significant difference in complain from fatigue and dyspnea at preoperative period and increase in control group than study group when analyzed by Chi-square test.

Table (6) The Comparison between Study and Control Groups for Six Minutes Walking, Dyspnea ; Fatigue ; Stopped and Total distance in Postoperative Period

	variables	Study group		Control group		C.S
		No	%	No	%	P= 0.0001
Stopped or paused after 6 minutes walking	Yes	6	20.0	21	70.0	S
	No	24	80.0	9	30.0	
Reason (after 6 min)	Pain	3	50.0	-	-	P = 0.001
	Dizziness	-	-	13	65.0	S
	Dyspnea	3	50.0	7	35.0	
Dyspnea (Brog scale) post-operative	Light	11	36.7	1	3.3	P =0.001
	Fairly light	14	46.7	12	40.0	S
	Hard	5	16.7	17	56.7	
	Fairly Hard	-	-	-	-	
Fatigue (Brog scale) Post-operative	Light	15	50.0	3	10.0	P =0.0001
	Fairly light	13	43.3	7	23.3	S
	Hard	2	6.7	20	66.7	
	Fairly Hard		-	-	-	
Total distance walked in 6 minutes/m post-operative		3.6±1.1 (1-5)		2.2±0.9 (1-4)		P=0.0001 S

Variable presented as mean ± Standard deviation or as absolute frequency (relative frequency):[1]: Student's t test; [2]: Chi-square continuity correction test;

It appears from table (6) that there is significant difference in complain from fatigue and dyspnea at postoperative period and increase in control group than study group when analyzed by Chi-square test.

V.   Discussion

In the last years, the 6MWT has become one of the most popular clinical exercise test for evaluating functional capacity. It is a practical, simple, and inexpensive test, and does not require any exercise equipment or advanced training for technicians. The test has close similarities to activities of daily living and can be performed by many elderly, frail, and severely limited patients who could not be evaluated by standard maximal symptom-limited exercise tests, as are cardiac patients after recent major surgery. The test is widely employed in cardiac rehabilitation in various categories of patients (after cardiac surgery, after myocardial infarction, chronic heart failure), both as a functional status indicator and as an outcome measure.

The preoperative physiotherapy in cardiac surgery includes functional assessment, orientation of the procedures to be performed and their relationship with the respiratory capacity for recovery of the patient, and to identify possible risk of respiratory complications after surgery there is no significant differential between those patients that receive preoperative pulmonary training instructions and those that do not in the following variables: age, sex, BMI, the results of our the study reveal that most of the patients overweight with the highest percentage is13(43.0%) in the study group and 12(40%) in the control group (table 1)

Thirapatarapong and Chumwong compared the differences between the two groups, the authors used statistical significance among several variables. Regarding the baseline characteristics such as age, sex and comorbidities, there is no significant difference between the two groups [4]

This result agrees with study conducted by Ragawanti which reportes that the BMI mean at first assessment in group I is 25.56 ± 3.20 kg/m2 and at second assessment decreases to 25.44 ± 3.04 kg/m2. Mean while in group II there is an increase of BMI found from 23.10 ±2.16 kg/m2to 23.33 ± 2.12 kg/m2. Subjects characteristics based on risk factors are also assessed [5] ,Our study reveales that there is no significant differences between the study and the control groups related to past medical history(Hypertension, Diabetes, Respiratory tract infection) when analyzed by chi-square (table 2). This result agrees with Savci et al who report that there is no significant difference in baseline characteristics and preoperative risk factors (hypertension, diabetes mellitus, hyperlipidemia, alcohol consumption, inactivity, and family history) between the groups [6] . Our study shows that the percentage of the study group is 22(73.3) where the highest

percentage in control group is 23 (76.6) in class three (NYHA) and Preoperative Left Ventricular Ejection Fraction (LVEF) the highest percentage is 21(70%) of the patients in the study group ,while 20 (66.7%) of patients in the control group had ejection fraction from (40-59%) (table 2). The result agrees with Yánez-Brage et al stat that the most of the patients had an NYHA functional grade of between 2 (41.4%) and 3 (46.6%).[7]

our study reveal that the highest percentage for Days of Hospitalization in the Intensive Care Unit (ICU (24) hours 26(86.7%) for study and 18(60%) for control group and there is significant difference between study and control group related to the number of days in ICU the result agree with Savci et al. The length of intensive care unit stay is significantly longer in the control group than the intervention group (p 0.05).[8]

This study reveal that there is a highly significant percentage 20(66.7%) in control group while 13(43.3) of the study group who were still on ventilator in the ICU at the range (5-9) hours. (table 3),These results agree with the study by Branea et al., [8] who mentions that these patients are ventilated longer, requiring longer Intensive Care Unit (ICU) stay. The influence on the duration of hospital admission and costs Our study reveal that there are highly significant differences between preoperative and postoperative for pulmonary function test related to the force vital capacity ,force expiratory volume in one second , percentage for force vital capacity at force expiratory volume in one second and peak expiratory flow for the study group when analyzed (table 4) Support of this study Morsch et al who state that the assessments are conduct preoperatively and at six days after surgery, where there is significant reduction in end-expiratory volume (EEV1), forced vital capacity (FVC) and VMS expressed in maximal inspiratory pressure and pressure maximal expiratory comparing the preoperative period to the sixth postoperative day. [11] Oliveira suggests that the reduction in forced vital capacity (FVC) and forced expiratory volume in one second (FEV1) occur by increased respiratory work and shallow breathing, due to pain and decreased chest expansion secondary to median sternotomy and thoracic manipulation, resulting in restrictive respiratory dysfunction in the postoperative period [12] The researcher confirmed that the pulmonary function reduced on the fourth post-operative day of CABG of the pre-operative values. Our study reveals that there is highly significant differences decreased in the distance covered in the 6 minutes walking between the study group and control group in preoperative when analyzed by Chi-square test(table6).

This result disagrees with the study conducted by Guizilini et al., In both groups, there is a significant decrease in the distance covered in the 6MWT compared with preoperative absolute values (P <0.0001). When groups are compared, patients in group SI walked significantly more than patients in Group II (P = 0.0001) [9].

Oliveira reports that the distance walked in 6-MWT in the fifth postoperative day have significant negative correlation with the length of postoperative hospital stay, with P = 0.0058 and rho = - 0.62 There is no significant correlation of the 6-MWT distance between the age (P = 0.4680 and r = - 0.18) and LVEF (P = 0.8070 and r = -0.06) [10]

Conclusion and Recommendations:

There is a significant reduction in pulmonary function occurs in both groups and mention that pulmonary tanning instruction on phase I cardiovascular rehabilitation preoperative pulmonary training instruction after CABG surgery results in clinically significant change in six minute walking distance.

The researcher recommended suggestions to The preoperative training instruction for patient with CABG Pamphlets and manuals should be described to orient patients about the preoperative pulmonary training and instruction to prevent postoperative pulmonary complication, Portable pulmonary function test should be available in ICU and training the Critical care nurse about how to use it

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