



## Effect of Blood Flow Restriction Low Resistance Exercise on Hemodynamic for Coronary Artery Disease Patients: Randomized Control Trial

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<p><b>CORRESPONDING AUTHOR:</b> Zaman G. Ghazal, Adult Nursing Department , College of Nursing, University of Kufa, Najaf, Iraq.                  Email: <a href="mailto:zamang.ali@student.uokufa.edu.iq">zamang.ali@student.uokufa.edu.iq</a></p>	<p><b>ABSTRACT</b></p> <p><b>Background:</b> Coronary artery disease (CAD) (also known as ischemic heart disease (IHD) or coronary heart disease (CHD) ) continues to be a leading cause of mortality in industrialized nations despite the tremendous advancements made in recent decades in the treatment and prevention of CAD. During physical activity or as part of ischemic preconditioning, the blood flow restriction low resistance (BFRLR) technique involves applying high pressure with a tourniquet, to the proximal part of the limb (arm or leg) in order to reduce arterial blood flow and shut down venous blood flow (Wilk et al., 2022).</p> <p><b>Objectives:</b> To determine the effectiveness of blood flow restriction low resistance exercise on the patients with coronary artery disease.</p> <p><b>Methodology:</b> A randomized control trial was performed on 100 patients referred for (the cardiac rehabilitation unit, and consultation) for AL-Najaf Center for Cardiac Surgery and Cardiac Catheterization. Patients were selected through non-probability (purposively) and were randomly assigned into two groups of (50) patients in each group. The study group has been exposed to blood flow low resistance restriction exercises by the researcher. The group that has not been exposed to blood flow low resistance restriction exercises by the researcher is considered the control group. The study started from period 9 th February 2023 to 6th July 2023.</p> <p><b>Results:</b> The results of the study showed that there is a significant difference between the study group and the control group post the blood flow restriction low resistance exercise.</p> <p><b>Conclusion:</b> The study result stated that the patients in the study group who received the blood flow restriction low resistance exercise had a decrease in (heart rate, and blood pressure), and improve Spo2 compared to the control group.</p> <p><b>Recommendations:</b> Nursing staff should be trained on how to deal with patients with coronary artery disease in cardiac rehabilitation centers through interest in such programs of blood flow restriction low resistance exercise.</p> <p><b>Keywords:</b> coronary artery disease, blood flow restriction low resistance exercises, hemodynamic.</p>
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## INTRODUCTION

Coronary artery disease (CAD), also known as coronary heart disease (CHD), ischemic heart disease (IHD), and atherosclerotic heart disease, is the most prevalent kind of cardiovascular disease in adults (43% of all cardiovascular disorders), it is also the main cause of death in the globe, According to Hinkle and Cheever (2018). a study by Dai et al., (2016), atherosclerotic coronary artery disease (CAD) is characterized by a wide variety of clinical symptoms, including asymptomatic subclinical atherosclerosis and its consequences, including angina pectoris (PA), acute myocardial infarction (MI), and sudden cardiac death (SCD). Although cases of atherosclerotic CAD with a monogenic etiology have been described, the etiology of CAD is incredibly heterogeneous. CAD is thought to have a complex multifactorial etiology, as it results from the interaction of many genetic and environmental factors (such as diet, physical activity, smoking, and other comorbidities) (Butnariu et al., 2022). Recent years have witnessed a huge increase in the use of blood flow restriction (BFR) treatment, a regulated form of vascular occlusion paired with low resistance training or exercise. The understanding of BFR's physiologic mode of action has advanced along with public awareness of BFR. This has revealed several advantages besides muscle growth, such as increased bone density, cardiovascular fitness, and muscular endurance (Cognetti et al., 2022). During physical activity or as part of ischemic preconditioning, the blood flow restriction low resistance (BFRLR) technique involves applying high pressure with a tourniquet, to the proximal part of the limb (arm or leg) in order to reduce arterial blood flow and shut down venous blood flow (Wilk et al., 2022). It's also possible that blood flow restriction low resistance training causes hemodynamic reactions by over-activating the press or reflex in response to external mechanical compression on the artery walls. Heart rate (HR), blood pressure (BP), and systemic vascular resistance (SVR) tend to rise as a result of the resulting sympathetic hyperactivity. (Lopes et al., 2021).

## AIMS OF THE STUDY

To determine the effectiveness of blood flow restriction low resistance exercise on the patients with coronary artery disease.

## METHODOLOGY

A randomized control trial was performed on 100 patients referred for (cardiac rehabilitation unit, and consultation) for AL-Najaf Center for Cardiac Surgery and Cardiac Catheterization. Patients were selected through non-probability (purposively) and were randomly assigned into two groups of (50) patients in each group. The study group has been exposed to blood flow restriction low resistance exercises by the researcher. The group that has not been exposed to blood flow low resistance restriction exercises by the researcher is considered the control group. The study was not initiated until approval was obtained for ethical considerations. The criteria for the selection of the study sample were (patients with coronary artery disease, patient consent and readiness to enter the program, optimum medical treatment (patient compliance to medication and diet), and adult patients with 18-69 years).

Data was obtained from the patients with coronary artery disease through the interview questionnaire form, which includes two parts. **Part I:** demographic and clinical data such as (smoking status, body mass index, Diseases Duration, past medical history, and past surgical history). **Part II:** The measurement of the effect of blood flow restriction low resistance exercise on hemodynamics in coronary artery disease patients through the hemodynamics parameters checklist consisting of (3) items (mean arterial pressure, heart rate, and oxygen blood saturation).

The researcher measures the patients, and parameters on the pretest and posttest (1, 2, and 3). In the current study, the researcher used (a **tension robe**) while restricting the blood flow from the thigh

area and starting the movement by extending the leg and bending and same method but restricting the blood flow from the humerus to both hands and starting pulling and extending the hand. The exercise was repeated (20 times/ minute), and this exercise continues (five times/day) for 5 days during the week. The training exercise was applied only to the study group for 6 weeks, and the researcher measured the effects of exercise every (two weeks). The Statistical Analysis: The data of the present study is analyzed through the application of two statistical approaches which include descriptive statistics: (frequencies, Percentages, Mean of Score, and Persons' correlation) and inferential statistics (the Friedman test, Mann–Whitney U test).

## RESULTS

**table (1):** Regarding age; the mean of patients' age in the control and study group were (51.42, and 51.16) respectively. Concerning Gender, the most of patients in both groups is male (98%) in control patient and (94%) in study patients. Regarding level of education (28%) of participants in the control group with intermediate school while (32%) of participant the study group primary school. Concerning monthly income, the majority of participants in control and study groups with less than 600000 DI (64%, and 82%) respectively. **table (2).** Shows the majority participants in control and study groups were active smokers (60%, and 62%) respectively. Regarding disease duration demonstrated control and study groups participants the mean (4.84, 5.76). concerning the body mass index, the control and study groups participants the mean (29.56, 30.95) obesity body. Shows the hypertensive the study sample of both control and study groups participants (98%, and 100%) respectively. Regarding the diabetic to control groups (60%) of participant and the study groups participants were that (56%) from not suffering diabetic. Shows the control groups participants were suffering from peripheral vascular disease (52%), and study groups participant 60% are not. (98%) of the

participants in control group had a procedure for coronary artery bypass graft, while (98%) of the study group participants are not. **table (3)** indicate that there is a significant difference in (MABP, H. R) for control group between pretest and posttest (1, 2, 3) at p-value (0.05). This result mean that the (MABP, H.R) for control groups participants are deteriorate. **table (4)** shows that there is a significant deference in (MABP) of study group between pretest and posttest (1, 2, 3) at p-value (0.05). While (H.R, Spo2) a remain within normal limit. The patients in the study group responses to the (BFRRE). **table (5)** presents that there is a non-significant difference between control and study groups regarding (MABP, HR, Spo2) in pre- test, while there is a significant difference between control and study in post (1, 2 ,3) of p-value (0.05). While the table (5) show a significant difference between for control and study groups at p-value (0.05). that mean the patient in study group response to (BFRRE).

## DISCUSSION: The Hemodynamic Status for coronary artery disease patient

Regarding of hemodynamic, the results of current study showed that a significant improved in post-test hemodynamic status for study group than the control group. The presented study result corresponded with the study done by. Esmailiyan et al., (2021), entitle "Effect of Different Types of Aerobic Exercise on Individuals with and Without Hypertension: An Updated Systematic Review", confirmed that exercise training showed to be useful in reducing Blood pressure in all groups either and the rate of reduction was different in terms of gender. Caminiti et al., (2020), note that there was a response in the exercises to the effect of blood pressure pre using the exercise and post using the exercise for 12 weeks that there is a change in blood pressure towards down curve. The finding of a study done Keech et al., (2020) entitle "High-intensity interval training for patients with coronary artery disease: Finding the optimal balance", reported that current

appears the cardiac rehabilitation is more safe for patient coronary artery disease. Improved aerobic fitness, blood pressure and body fat levels that indicating improved in cardiovascular risk. Waheed and Hassan (2021) confirm by study Regular exercise can enhance cardiovascular health by physical activity in addition enhancement hemodynamic parameter to simply modifying well-known risk factors for systemic CVD. The presented study result corresponded with the study done by Boeno et al., (2020), aim to " evaluate hypertension middle age patients during low resistance exercise" there were effected exercise pre and post that were result resistance training are beneficial for blood pressure control and cardiovascular disease risk reduction. The study conducted by Grafe et al., (2018) and entitle "Effects of Resistance Training on Vascular and Hemodynamic Responses in Patients with Coronary Artery Disease" confirmed that trained cardiac patients, a supplemental resistance exercise program resulted in decreased hemodynamic and rating of perceived exertion responses to lifting fixed submaximal workloads. Nascimento et al., (2017), entitle "Acute and chronic effects of aerobic exercise on blood pressure in resistant hypertension: study protocol for a randomized controlled trial" reported that aerobic exercise reduces blood pressure, autonomic modulation and hemodynamics, improves parasympathetic modulation, pressure sensitivity, and vasodilator response and reduces sympathetic modulation and vascular resistance. The results of a study According to Hassan and Naseer (2015), cardiac rehabilitation programs had a greater positive impact on patients' quality of life, body mass index, body weight, blood pressure, resting heart rate and death rate, as well as reduced myocardial infarction risk factors. Moreover, Botega et al., (2011) they studied "Cardiovascular response [corrected] during rehabilitation after coronary artery bypass grafting". The exercises proposed proved to be safe with the change in key physiologic variables throughout the experiment below recommended values for the

hospitalization phase. The researcher confirms that the patients are under the study group that blood flow low resistance restriction exercises had a decrease in mean arterial blood pressure, heart rate, and blood pressure and Spo2 after program activity. The researcher noticed that there is a significant improvement compared to the control group, as a result of the application of the cardiac rehabilitation program for patients with coronary arteries. The blood flow low resistance restriction exercise very useful to hemodynamic activity, change vascularity size and other.

### CONCLUSIONS:

The study concluded that the patients in study group who receiving the blood flow restriction low resistance exercise had improving in the (heart rate, and blood pressure and Spo2) compared to the control group.

### RECOMMENDATIONS:

Nursing staff should be trained on how to deal with patients with coronary artery disease in cardiac rehabilitation centers through interest in such programs of blood flow restriction low resistance exercise.

### REFERENCES:

- Hinkle, J. L., & Cheever, K. H. (2018). Brunner and Suddarth's textbook of medical-surgical nursing. Wolters kluwer india Pvt Ltd.
- Dai X., Wiernek S., Evans J.P., Runge M.S. Genetics of coronary artery disease and myocardial infarction. *World J. Cardiol.* 2016;8:1–23. doi: 10.4330/wjc.v8.i1.1.
- Butnariu, L. I., Florea, L., Badescu, M. C., Țarcă, E., Costache, I. I., & Gorduza, E. V. (2022). Etiologic Puzzle of Coronary Artery Disease: How Important Is Genetic Component?. *Life* (Basel, Switzerland), 12(6), 865. <https://doi.org/10.3390/life12060865>.
- Cognetti, D. J., Sheean, A. J., & Owens, J. G. (2022). Blood flow restriction therapy and its use for

- rehabilitation and return to sport: physiology, application, and guidelines for implementation. *Arthroscopy, sports medicine, and rehabilitation*, 4(1), e71-e76.
- Wilk, M., Krzysztofik, M., Filip, A., Zajac, A., Bogdanis, G. C., & Lockie, R. G. (2022). Short-term blood flow restriction increases power output and bar velocity during the bench press. *Journal of strength and conditioning research*, 36(8), 2082-2088.
- Lopes, K. G., Farinatti, P., Bottino, D. A., DE Souza, M., Maranhão, P. A., Bouskela, E., Lourenço, R. A., & DE Oliveira, R. B. (2021). Does resistance training with blood flow restriction affect blood pressure and cardiac autonomic modulation in older adults?. *International journal of exercise science*, 14(3), 410-422.
- Eisinga, R.; Heskens, T.; Pelzer, B.; Te Grotenhuis, M. (2017). "Exact p-values for pairwise comparison of friedman rank sums, with application to comparing classifiers". *BMC Bioinformatics*. 18 (1): 68.
- Karch, Julian (2021). "Psychologists Should Use Brunner–Munzel's Instead of Mann–Whitney's U Test as the Default Nonparametric Procedure". *Advances in Methods and Practices in Psychological Science*. 4 (2).
- Esmailian, M., Amerizadeh, A., Vahdat, S., Ghodsi, M., Doewes, R. I., & Sundram, Y. (2021). Effect of different types of aerobic exercise on individuals with and without hypertension: An updated systematic review. *Current problems in cardiology*, 101034.
- Caminiti G, Iellamo F, Mancuso A, Cerrito A, Montano M, Manzi V, Volterrani M. Effects of 12 weeks of aerobic versus combined aerobic plus resistance exercise training on short-term blood pressure variability in patients with hypertension. *J Appl Physiol* (1985). 2021 Apr 1;130(4):1085-1092. doi: 10.1152/jappphysiol.00910.2020. Epub 2021 Feb 25. PMID: 33630677.
- de Bakker, M., den Uijl, I., Ter Hoeve, N., van Domburg, R. T., Geleijnse, M. L., van den Berg-Emons, R. J., ... & Sunamura, M. (2020). Association between exercise capacity and health-related quality of life during and after cardiac rehabilitation in acute coronary syndrome patients: a substudy of the OPTICARE randomized controlled trial. *Archives of Physical Medicine and Rehabilitation*, 101(4), 650-657.
- Bassi, D., Mendes, R. G., Arakelian, V. M., Caruso, F. C. R., Cabiddu, R., Júnior, J. C. B., ... & Borghi-Silva, A. (2016). Potential effects on cardiorespiratory and metabolic status after a concurrent strength and endurance training program in diabetes patients—a randomized controlled trial. *Sports Medicine-Open*, 2(1), 1-13.
- Cacoub, P. P., Abola, M. T. B., Baumgartner, I., Bhatt, D. L., Creager, M. A., Liao, C. S., ... & REACH Registry Investigators. (2009). Cardiovascular risk factor control and outcomes in peripheral artery disease patients in the Reduction of Atherothrombosis for Continued Health (REACH) Registry. *Atherosclerosis*, 204(2), e86-e92.
- Dobarro, D., Castrodeza-Calvo, J., Varela-Falcón, L., Varvaro, G., Coya, M. J., Martín, C., Alonso, C., Veras, C., Tobar, J., Goncalves-Ramírez, L. R., Vera, L., López, J., & San Román, J. A. (2020). Exercise right heart catheterization predicts outcome in asymptomatic degenerative aortic stenosis. *Revista espanola de cardiologia (English ed.)*, 73(6), 457-462. <https://doi.org/10.1016/j.rec.2019.03.005>.
- Esmailian, M., Amerizadeh, A., Vahdat, S., Ghodsi, M., Doewes, R. I., & Sundram, Y. (2021). Effect of different types of aerobic exercise on individuals with and without hypertension: An updated systematic review. *Current problems in cardiology*, 101034.
- Keech, A., Holgate, K., Fildes, J., Indraratna, P., Cummins, L., Lewis, C., & Yu, J. (2020). High-intensity interval training for patients with coronary artery disease: Finding the optimal balance. *International journal of cardiology*, 298, 8-14.
- Waheed, M. R., & Hassan, H. B. (2021). Effectiveness of daily living activities program on total cholesterol, low-density lipoprotein, and high-density lipoprotein of patients with coronary artery disease. *Kufa Journal*

- for *Nursing Sciences*, 11(2), 188–200. <https://doi.org/10.36321/kjns.vi20212.2064>.
- Boeno FP, Ramis TR, Munhoz SV, Farinha JB, Moritz CEJ, Leal-Menezes R, Ribeiro JL, Christou DD, Reischak-Oliveira A. Effect of aerobic and resistance exercise training on inflammation, endothelial function and ambulatory blood pressure in middle-aged hypertensive patients. *J Hypertens*. 2020 Dec;38(12):2501-2509. doi:
- Grafe K, Bendick P, Burr M, Boura J, Franklin BA. Effects of resistance training on vascular and hemodynamic responses in patients with coronary artery disease. *Res Q Exerc Sport*. 2018 Dec;89(4):457-464. doi: 10.1080/02701367.2018.1519385. Epub 2018 Oct 9. PMID: 30300089.
- Nascimento, L., Santos, A., Lucena, J. et al. Acute and chronic effects of aerobic exercise on blood pressure in resistant hypertension: study protocol for a randomized controlled trial. *Trials* 18, 250 (2017). <https://doi.org/10.1186/s13063-017-1985-5>.
- Hassan, H. S., & Naseer, A. A. A. (2015). Effectiveness of educational program on nurses knowledge toward rehabilitation for patients with cardiac heart attack. *Kufa Journal for Nursing Sciences*, 5(2), 342–348. <https://doi.org/10.36321/kjns.vi20152.2577>.
- Botega Fde S, Cipriano Junior G, Lima FV, Arena R, da Fonseca JH, Gerola LR. Cardiovascular response [corrected] during rehabilitation after coronary artery bypass grafting. *Rev Bras Cir Cardiovasc*. 2010 Oct-Dec;25(4):527-33. doi: 10.1590/s0102-76382010000400017. Erratum in: *Rev Bras Cir Cardiovasc*. 2011.

#### TABLES:

Table (1): Distribution of Socio-Demographic Characteristics for both Study and Control Groups

Variables	Categories	Statistics	Grouping	
			Control	Study
Age	31 - 40	F.	7	9
		%	14.0%	18.0%
	41 - 50	F.	17	15
		%	34.0%	30.0%
	51 - 60	F.	16	15
		%	32.0%	30.0%
	61 - 70	F.	10	11
		%	20.0%	22.0%
Mean + S.D.			<b>51.42</b>	<b>51.16</b>
			<b>9.49</b>	<b>10.13</b>
Gender	Male	F.	49	47
		%	98.0%	94.0%
	Female	F.	1	3
		%	2.0%	6.0%
Total			<b>50</b>	<b>50</b>
Level of Education	Doesn't read and write	F.	1	3
		%	2.0%	6.0%
	Read & write	F.	6	11
		%	12.0%	22.0%
	Primary school	F.	11	16
		%	22.0%	32.0%
	Intermediate school	F.	14	5
		%	28.0%	10.0%

	<b>Secondary school</b>	<b>F.</b>	8	6
		<b>%</b>	16.0%	12.0%
	<b>Institute graduate</b>	<b>F.</b>	8	6
		<b>%</b>	16.0%	12.0%
	<b>University graduate</b>	<b>F.</b>	2	3
		<b>%</b>	4.0%	6.0%
	<b>Total</b>		<b>50</b>	<b>50</b>
<b>Monthly Income</b>	<b>&lt;= 600000</b>	<b>F.</b>	32	41
		<b>%</b>	64.0%	82.0%
	<b>600001 - 900000</b>	<b>F.</b>	9	1
		<b>%</b>	18.0%	2.0%
	<b>900001 - 1200000</b>	<b>F.</b>	7	6
		<b>%</b>	14.0%	12.0%
	<b>1200001 - 1500000</b>	<b>F.</b>	2	2
		<b>%</b>	4.0%	4.0%
	<b>Mean + S.D.</b>		<b>509400</b>	<b>374700</b>
			<b>400246.9</b>	<b>386111.4</b>

%= percentage, freq. = frequency, S.D. = Standard Deviation.

**Table (2):** The Distribution of the Clinical Characteristics for both Study and Control Groups

<b>Variables</b>	<b>Categories</b>	<b>Statistics</b>	<b>Grouping</b>	
			<b>Control</b>	<b>Study</b>
<b>Smoking</b>	<b>Active</b>	<b>F.</b>	30	31
		<b>%</b>	60.0%	62.0%
	<b>Passive</b>	<b>F.</b>	11	9
		<b>%</b>	22.0%	18.0%
	<b>None</b>	<b>F.</b>	6	8
		<b>%</b>	12.0%	16.0%
	<b>Ex-smoker</b>	<b>F.</b>	3	2
<b>%</b>		6.0%	4.0%	
	<b>Total</b>		<b>50</b>	<b>50</b>
<b>Disease Duration</b>	<b>&lt;= 5</b>	<b>F.</b>	33	26
		<b>%</b>	66.0%	52.0%
	<b>6 - 10</b>	<b>F.</b>	17	22
		<b>%</b>	34.0%	44.0%
	<b>16+</b>	<b>F.</b>	0	2
		<b>%</b>	0.0%	4.0%
	<b>Mean + S.D.</b>		<b>4.84</b>	<b>5.76</b>
			<b>2.27</b>	<b>3.32</b>
<b>BMI</b>	<b>Normal</b>	<b>F.</b>	4	2
		<b>%</b>	8.0%	4.0%
	<b>Overweight</b>	<b>F.</b>	22	17
		<b>%</b>	44.0%	34.0%
	<b>Obesity</b>	<b>F.</b>	24	31
		<b>%</b>	48.0%	62.0%

		Mean + S.D.		29.56	30.95
				3.36	3.43
Chronic Diseases	Hypertension	Yes	F.	49	50
			%	98.0%	100.0%
		No	F.	1	0
			%	2.0%	0.0%
	DM	Yes	F.	30	22
			%	60.0%	44.0%
		No	F.	20	28
			%	40.0%	56.0%
	PVD	Yes	F.	26	20
			%	52.0%	40.0%
		No	F.	24	30
			%	48.0%	60.0%
	CABG	Yes	F.	2	1
			%	4.0%	2.0%
	No	F.	48	49	
		%	96.0%	98.0%	
CC	Yes	F.	33	31	
		%	66.0%	62.0%	
	No	F.	17	19	
		%	34.0%	38.0%	
<b>Total</b>				<b>50</b>	<b>50</b>

%= percentage, freq. = frequency, S.D. = Standard Deviation, BMI=Body Mass Index, DM=Diabetic Mellitus, PVD= Peripheral Vascular Disease, CABG= Coronary Artery Bypass Graft, CC=Cardiac Catheterization, Normal value to BMI=(18-24normal), (24-29 over weight), (30+ obese).

**Table (3):** Comparison of Patient Hemodynamic Parameters of Control Group between Pre and Posttest 1, Posttest 2, and Posttest 3

Variables	Period of Measurement	Mean	S.D.	Mean Rank	Friedman Test (Chi-Square)	d.f.	P-value
M.A.B.P	Pre-Test	115.22	7.582	1.33	90.969	3	0.000
	Post-Test1	117.90	7.926	2.19			
	Post-Test2	120.32	8.421	2.80			
	Post-Test3	123.14	8.720	3.68			
H.R.	Pre-Test	94.48	7.066	1.00	138.881	3	0.000
	Post-Test1	101.96	8.451	2.08			
	Post-Test2	109.66	10.489	3.07			
	Post-Test3	116.24	11.335	3.85			
SPo2	Pre-Test	96.82	0.560	2.13	26.418	3	0.000
	Post-Test1	96.94	0.470	2.36			
	Post-Test2	97.12	0.435	2.71			
	Post-Test3	97.18	0.482	2.80			

% = percentage, S. D= standard deviation, d.f.=degree of freedom, p.value=0.05, MABP=mean arteria blood pressure, H.R.=heart rate, SPO2=saturation of peripheral oxygen, normal value to MABP= (70-100), normal value to H.R.= (60-100), normal value SPo2= (95-100).

**Table (4):** Comparison of Patient Hemodynamic Parameters of Study Group between Pre and Posttests

Variables	Period of Measurement	Mean	S.D.	Mean Rank	Friedman Test (Chi-Square)	d.f.	P-value
M.A.B.P	Pre-Test	118.06	10.460	3.98	130.7	3	0.000
	Post-Test1	110.72	10.977	2.70			
	Post-Test2	107.02	10.209	2.24			
	Post-Test3	96.46	10.994	1.08			
H.R.	Pre-Test	88.80	10.174	1.79	39.0	3	0.000
	Post-Test1	94.78	16.018	2.76			
	Post-Test2	90.54	11.227	2.18			
	Post-Test3	98.68	0.713	3.27			
SPo2	Pre-Test	96.90	1.055	1.80	89.9	3	0.000
	Post-Test1	97.06	0.890	1.93			
	Post-Test2	97.72	0.640	2.65			
	Post-Test3	98.62	0.725	3.62			

% = percentage, S. D= standard deviation, d.f.= degree of freedom, p.value=0.05, MABP=mean arteria blood pressure, H.R.=heart rate, SPO2=saturation of peripheral oxygen, normal value to MABP= (70-100), normal value to H.R.= (60-100), normal value SPo2= (95-100).

**Table (5):** Comparison of Patient's Hemodynamic Parameters of Study and Control Groups

Grouping	Grouping	Mean Rank	Sum of Ranks	Mann-Whitney Test	P-value	
M.A.B.P.	Pre-Test	Control	46.59	2329.50	1054.5	0.177 NS
		Study	54.41	2720.50		
	Post-Test 1	Control	60.49	3024.50	750.5	0.000 S
		Study	40.51	2025.50		
	Post-Test 2	Control	67.41	3370.50	404.5	0.000 S
		Study	33.59	1679.50		
	Post-Test 3	Control	73.81	3690.50	84.5	0.000 S
		Study	27.19	1359.50		
H.R.	Pre-Test	Control	60.09	3004.50	770.5	0.0009 S
		Study	40.91	2045.50		
	Post-Test 1	Control	59.64	2982.00	793.0	0.001 S
		Study	41.36	2068.00		
	Post-Test 2	Control	69.86	3493.00	282.0	0.000 S
		Study	31.14	1557.00		
	Post-Test 3	Control	74.05	3702.50	72.5	0.000 S
		Study	26.95	1347.50		
SPo2	Pre-Test	Control	49.17	2458.50	1183.5	0.617 NS
		Study	51.83	2591.50		
	Post-Test 1	Control	47.77	2388.50	1113.5	0.286 NS
		Study	53.23	2661.50		
	Post-Test 2	Control	37.76	1888.00	613.0	0.000 S
		Study	63.24	3162.00		
	Post-Test 3	Control	29.98	1499.00	224.0	0.000 S
		Study	71.02	3551.00		

NS = Non-Significant, S = Significant, MABP=mean arteria blood pressure, H.R.=heart rate, SPO2=saturation of peripheral oxygen, normal value to MABP= (70-100), normal value to H.R.= (60-100), normal value SPo2= (95-100).