

Cardiac Rehabilitation For CABG Patients in South Indian Setup : A Prospective Study

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Abstract

Objective: To evaluate the effectiveness of structured cardiac rehabilitation program in Indian setup

Methods: The study was carried out in an institutional setup involving seventy four patients who underwent coronary artery bypass surgery (CABG). The patients were evaluated prior to surgery and were initiated into lifestyle changes based on Diet, Relaxation, Exercise, Attitude and Motivation (DREAM) concept on discharge post operatively. The patients were advised unsupervised walking exercise based on target heart rate of 60 – 75% based on age. The follow-up was made every fifteen days.

The outcomes were functional capacity as measured by treadmill test 3 months post-operatively, lipid and glucose profiles and anthropometric indices viz. body mass index (BMI) and waist to hip ratio (WHR). The measures were compared for pre- and 3 months post- operatively. The results were analysed for significance using student t-test by SPSS 10.0 for windows.

Results & Conclusion : There was a favourable change in functional capacity (11.4 + 1.59 METS), resting rate pressure double product, fasting blood sugar, total cholesterol, triglycerides and anthropometric indices. These changes achieved 3-months post-operatively are in conformity with the existing data on westernpatients who undergo supervised exercises.

The results suggest an encouraging pattern for effective cardiac rehabilitation program that can also be used for secondary prevention of Coronary Artery Disease in India.

Key words : Coronary artery disease, cardiac rehabilitation, diet, exercise, attitude, motivation, relaxation, prevention.

Introduction

Health as defined by WHO¹ is a state of mental, physical and social well-being and not merely the absence of disease or infirmity and this applies as a whole to rehabilitation of cardiac patients. Cardiac rehabilitation (CR) is the enhancement and maintenance of

cardiovascular health through individualized programs designed to optimize physical, psychological, social, vocational and emotional status². CR aims to improve QOL, correction of risk factors and assistance to social and professional reintegration^{3, 4}

India has a large population of Coronary Artery Disease (CAD) patients⁵. At one point of time CAD patients undergo Coronary Artery Bypass Graft (CABG) surgery. This gives the

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scenario for effective cardiac rehabilitation ⁶ and improved health care delivery to such patients. CR is widely practiced all over the world as secondary prevention ⁷, for health promotion and rehabilitation as well. But the concept has not gained full acceptance in India. To give a comprehensive rehabilitation to coronary patients a prospective study was done at Apollo Hospitals.

Traditional concepts revolved around exercise ⁷ and did not really help in making people change the lifestyle habits. The study was conducted to look into the efficacy of a comprehensive CR program encompassing the psychological, social and physical well being of the patient ^{7,8}. The program was carried out on CABG patients to bring out the limitations/difficulties of a CR program in Indian setup and to evolve a structured program that could be followed by all patients in the community setup without being supervised. The program was named DREAM (Diet, Relaxation, Exercise, Attitude and Motivation), which incorporated the essentials of cardiac rehabilitation and health and to derive maximum benefit for the patient ^{8,9,10}. The program was conceived so that people could adopt and maintain lifestyle changes with persistence being emphasized.

Methods Subjects

Seventy-four (Males – 72, Females – 2) patients who underwent CABG from Chennai were enrolled into the study. All patients were preoperatively evaluated for risk factors ¹¹, Fasting Blood Glucose (FBS), lipid profile and anthropometric indices ¹² namely Body Mass Index (BMI) and Waist / Hip Ratio (WHR). Preoperative briefings about the risk factors, coronary artery disease and about the surgery were done.

Study Design

The 74 patients who underwent CABG

surgery were enrolled for the program and did not have any control group. The study was an intention to treat design. Patients were screened for congenital deformities, severe LV dysfunction, and musculoskeletal problems that might hinder them from doing exercises. No such patients formed part of the study. The patients who underwent surgery were given phase I and II rehabilitation in the in-patient setup ⁸. Upon discharge the patients were given the DREAM program.

Dream Program

The program was administered to patients in phase II in the form of progressive ambulation, Range Of Motion (ROM) exercises and energy conservation techniques. The patients were given the program upon discharge and were given educational material consisting of the components of the program. A briefing session with audio-visual presentation and patient group interaction was done. A self-evaluation chart consisting of all the components of the program were given to the patients so that the caretakers and the patients could keep track of the changes they undertake. At the end of three months Cardiac Stress Analysis (CSA) with Treadmill Test, FBS, fasting lipid profile and anthropometric measures were evaluated.

Diet

Dietary advices ^{9,10,14,15} were focused on secondary prevention ^{7,8} and also accounted for the risk factors of the individual patients. The patients were given personalized diet charts and advices. The briefing session educated the patients about the benefits of maintaining desirable levels of Serum Cholesterol, glucose and good dietary practices ¹³. The audiovisual aids emphasized the desirable changes to be adopted enlightening the scientific reasons. The patients were asked to manage and monitor their

BMI and WHR on a weekly basis. The handout containing the dietary guidelines had the patients' ideal weight listed in it.

Relaxation

Stress is an important factor leading to CAD^{9,10,16,17}. Also there is general anxiety before and after the surgery among the patients. Anxiety pertaining to health, activity and Activities of Daily Living (ADL) were the main concerns. To overcome stress and anxiety, relaxation techniques¹⁷ were taught to the patients. The techniques that included deep breathing exercises, visualization and meditation appeared more practical solutions to patients to help incorporate easily into their lifestyle without need for any special environment or equipment. The patients were taught visualization and meditation during the briefing session and were asked to practice them on a daily basis.

Exercise

Exercise^{2,8,9,10,18,19,20} or structured physical activity was started in Phase II. Progressive ambulation to minimize fatigue was emphasized and exercises to reduce edema, improve lung function and prevent stiffness in joints were also done. In phase III, walking was advised to improve the aerobic capacity. The protocol was based to attain 50 - 60% of target heart rate²⁰ with 5 minutes each of warm up and cool down periods. The walking program was graded with weekly increments of 2-3 minutes in the peak exercise period. The exercises were unsupervised and patients were asked to attain 30 minutes by the third month review. Energy conservation methods were also taught to the patients during their ambulation particularly climbing stairs.

Attitude

Attitude is the way we look at things or

life. In other words it is behavior. Modification of behavior^{16,21,22} underlies lifestyle modifications and this needs to be changed favorably if we need to have any results. The program identified anxiety / hurried nature, smoking, short temper, alcoholism and worries for modification. By changing these behavioral tendencies we can bring about a change in the patients' lifestyle and general health. These were the essential components in reducing stress and thereby the secondary event risk of CAD.

Motivation

Motivation^{21,22,23} is an important factor, which determines the outcomes of any intervention. Without the patient being motivated, adherence to CR will be a major limiting problem. To have the patients motivated and make them follow the program properly, a frequent follow up on every 15th day was emphasized. If the patients had any queries regarding the program they were clarified. The follow up were done till the third month review after surgery.

To reinforce the program a feed back form (self appraisal forms) were given to the patients. The form consisted of all the components of the DREAM. The patients have to score in the colour codes given to check out if they had followed the program or not. The chart was to be filled by the patient every day before sleep.

Statistical Methodology

Preoperative and postoperative third month FBS, lipid profile and the average of anthropometric measures, heart rate and blood pressure were tabulated. The baseline and subset values were analysed for any significant variations using independent t-test and there was no significant differences. The comparative data was analysed for significance using student t-test using SPSS 10.0 for windows.

The subsets of diabetics and nondiabetics, statins and non-statin group in dyslipidaemics, obese and non-obese based on preoperative BMI and the variation between follow-ups below and above 3 visits were analysed for the same set of variables. The variances were tested for significance using student t-test.

Outcome Measures

The outcome measures 3 months following CABG surgery, were

1. CSA (by treadmill test) - > 10 METS
2. FBS < 100 mg / dL
3. TC < 150 mg / dL
4. LDL < 100 mg / dL
5. HDL > 40 mg / dL
6. TGL < 150 mg / dL
7. LDL / HDL < 2.5
8. TC / HDL < 4.0
9. BMI < 23

VARIABLES			N = 74	
	NUMBER		NUMBER	%
AGE (YEARS)		53.2 + 8.09 (33 – 68)		
SEX				
MALE	72		97.3	
FEMALE	2		2.7	
DIABETES MELLITUS	19		25.67	
DYSLIPIDEMIA	49		66.21	
HYPERTENSION	34		45.94	
SMOKING	15		20.27	
OBESITY	27		36.48	
CENTRAL OBESITY	64		86.48	
FAMILY HISTORY OF CAD	40		54.05	
PRIOR MI	39		52.70	
VESSELS				
1	3		4.05	
2	15		20.27	
3	56		75.67	
LV FUNCTION				
NORMAL	64		86.48	
MILD DYSFUNCTION	4		5.40	
MODERATE DYSFUNCTION	6		8.10	

TABLE 1 : BASELINE CHARACTERISTICS

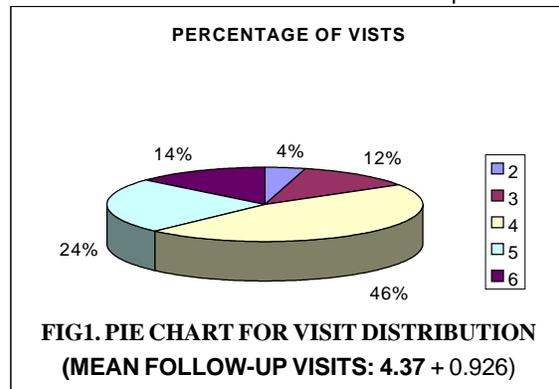
10. WHR < 0.9 for males, 0.8 for females

Results

In Table 1, the baseline characteristics of the study groups are shown. Mean age of the group was 53.20 (+ 8.09) years with age range of 33 – 68 years. Majority of patients were in their fifth and sixth decades of life (74%) [<40 years- 3 (4%); 41 – 50 years – 24 (32%); 51-60 years – 31 (42%); >60 years – 31 (42%)].

Male gender preponderance was noted to the order of 97.3%. About a quarter of the patients studied were diabetics and two thirds of the patient's revealed dyslipidaemia. Systemic hypertension as a risk factor was noted in 46% of the patients. Interestingly only about one-fifth of the study group had smoked earlier or were current smokers. Nearly about a third was either overweight or obese. About 52.7% of the group had prior MI before surgery indicating a higher risk group. However only <15% of the 74 patients had evidence of LV dysfunction of mild or moderate nature. Severe LV dysfunction group of patients did not form part of the study.

Angiographic characteristics showed nearly 75% of the patients had multi-vessel involvement. Mean number of visits for the cardiac rehabilitation programme was 4.375 + 0.926. Figure 1 shows the distribution of follow up visits. 84% of the patients had visited the cardiac rehabilitation unit in the hospital for 4



or more number of visits in the first three months following CABG surgery.

3-months of postoperative cardiac rehabilitation results were analysed with regard to biochemical, anthropometric, rate pressure double product at rest and tolerance to treadmill cardiac stress analysis. These figures were compared for statistically significant variation to indicate any favourable impact of the CR programme on the parameters considered.

Table 2 gives the comparative analysis among the various pre-operative and post-

operative variables. Statistically significant favourable deviation was noted in the overall postoperative FBS (P = 0.002), TC (P = 0.037), TC / HDL ratio (P = 0.007) and fasting TGL (P = 0.003) levels. Despite a significant reduction in the TC level at 3rd month postoperative follow-up, the mean TC level was however above the desired ideal value and was noted to be 159.49 + 41.61 mg / dL. However, no statistically significant deviation was noted with regard to mean LDL, HDL levels and the LDL/ HDL ratio. There was a definite trend for lower post-operative LDL level. Mean HDL cholesterol did not change significantly and was

VARIABLES	N = 74		p = *
	PREOP #	POSTOP#	
FBS	109.73 + 40.72	97.55 + 19.79	0.002
TCL	173.03 + 41.14	159.49 + 41.61	0.037
LDL	99.54 + 34.23	92.07 + 30.65	0.148
HDL	43.65 + 7.02	42.80 + 8	0.457
TGL	164.96 + 84.93	134.6 + 57.62	0.003
LDL / HDL	2.26 + 0.61	2.11 + 0.47	0.117
TCL / HDL	3.94 + 0.54	3.7 + 0.55	0.007
W / H	0.96 + 0.046	0.92 + 0.054	0.000
BMI	24.66 + 2.90	23.73 + 2.39	0.000
RPP	9615.94 + 1409.92	8840.56 + 1370.07	0.000

TABLE 2: COMPARISON OF PREOP AND POSTOP VALUES

* p Value at 95% confidence level using paired t-Test

MEAN + SD

being maintained without any fall.

On the anthropometric indices, a significant reduction was noted in the WHR ratio as well as BMI (P = 0.000 for both parameters). Physical fitness level and conditioning effect were noted during cardiac stress analysis with an average workload attained being 11.4 + 1.59 METs compared to preoperative mean of 3.62 + 0.82. A statistically significant lower RPP (P = 0.000) at rest was also observed, indicating the physical conditioning effect due to the rehabilitation.

Interesting observations were noted during various subset analyses, which are elaborated herein.

Diabetics and Non-Diabetics

Pre- and post-operative comparative analysis among this subset group (Table 3) showed statistically significant favourable deviation in the FBS levels and TC / HDL ratio,

WHR and BMI in both groups. A trend for lower post-operative values was noted with regard to TC, TGL and LDL / HDL ratio. Non-Diabetic patients maintained a higher mean TC and LDL levels both pre- and post-operatively which was much higher than the desired level of 150 mg/dL. The diabetic patients showed a post-operative mean TC value closer to the desired figure. Again an interesting observation was a higher mean pre- & post-operative serum TGL levels among non-diabetics which is quite contrary to the expectations. In view of relatively lower post-op LDL cholesterol levels (85.5 + 28.63 mg / dL) among the diabetic groups, the LDL / HDL was creeping towards the desirable figure. In tune with the expectation among the diabetic group the mean WHR and BMI were higher as compared to non-diabetic patients preoperatively and postoperatively indicating greater prevalence of obesity among the diabetic group. However both groups

VARIABLES	DIABETICS N = 19			NON DIABETICS N = 55		
	PREOP [#]	POSTOP [#]	p =	*MEAN [#]	ST. DEV. [#]	p =*
FBS	132.21+48.14	108.68+23.82	0.047	99.78+33.62	91.55+12.89	0.021
TCL	167.16+41.58	151+38.69	0.176	172.67+39.19	162.94+43.32	0.204
LDL	99.17+39.43	85.5+28.63	0.214	97.78+31.17	94.4+31.84	0.562
HDL	42.44+6.94	41.33+7.75	0.625	43.78+7.05	43.35+8.26	0.751
TGL	151.06+54.97	120.89+63.58	0.096	168.61+94.53	141.25+55.49	0.3
LDL / HDL	2.27+0.57	2.03+0.4	0.13	2.23+0.62	2.14+0.5	0.434
TCL / HDL	3.9+0.43	3.62+0.48	0.05	3.93+0.55	3.73+0.58	0.077
W / H	0.97+0.04	0.94+0.05	0.033	0.95+0.04	0.91+0.05	0.000
BMI	25.42+2.14	24.47+2.44	0.046	24.47+3.13	23.51+2.38	0.000

TABLE 3: COMPARISON BETWEEN DIABETICS AND NON-DIABETICS

* p Value at 95% confidence level using paired t-Test

[#]MEAN + SD

showed statistically significant reduction in post-op BMI & WHR, which was considerably more in nondiabetic subjects.

Dyslipidaemics and Non-Dyslipidaemics

the aimed objective to reach the target of < 150 mg / dL. 22.45 % of dyslipidaemics were diabetic as compared to 32 % among non-dyslipidaemic group. Among the study group only 28.38 % had received statins post operatively.

VARIABLES	DYSLIPIDAEMICS (N = 49)			NONDYSLIPIDAEMICS (N = 25)		
	PREOP [#]	POSTOP [#]	p =*	PREOP [#]	POSTOP [#]	p =*
FBS	111.31 +42.49	97.41 +21.40	0.006	103.57 +35.42	95.96 +13.94	0.232
TCL	192.86 +34.37	165.73 +40.79	0.001	130.78 +12.04	146.17 +41.07	0.062
LDL	114.59 +31.10	95.05 +29.41	0.002	68.11 +11.61	85.87 +32.89	0.025
HDL	46.58 +5.90	43.52 +7.81	0.009	37.52 +4.97	41.3 +8.37	0.035
TGL	179.08 +91.62	138.48 +64.45	0.004	135.48 +60.62	126.61 +39.88	0.386
LDL / HDL	2.45 +0.61	2.15 +0.43	0.006	1.84 +0.36	2.04 +0.54	0.207
TCL / HDL	4.15 +0.48	3.7886 +0.51	0.002	3.51 +0.36	3.52 +0.59	0.935
W / H	0.96 +0.04	0.93 +0.05	0.001	0.96 +0.047	0.92 +2.94	0.000
BMI	24.88 +2.96	23.86 +2.17	0.000	24.22 +2.80	23.48 +2.94	0.006

TABLE 4: COMPARISON BETWEEN DYSLIPIDAEMICS AND NONDYSLIPIDAEMICS

* p Value at 95% confidence level using paired t-Test

[#]MEAN + SD

A comparison of the above subset of patients (Table 4) yielded the following observation.

Mean FBS, HDL, TGL and BMI were higher among the dyslipidaemics. Similar WHR was noted in the two groups. Post-operative follow-up analysis showed significant reduction in TC, LDL, TGL, TC/ HDL ratio, WHR and BMI values among the dyslipidaemics. There was 6.6 % fall in HDL levels post-operatively in dyslipidaemic group contrary to 10 % rise in post-op HDL levels in non-dyslipidaemic group²⁰. The latter also showed significant rise in LDL level post-op though the absolute level of LDL was well within the desirable level of 100 mg / dL. The mean post-op TC levels in dyslipidaemia groups was however, higher than

Obesity and No-Obesity:

Obesity showed prevalence in 36.5% among the study group (table 5). The obese group showed higher mean pre-operative FBS, TGL and the non-obese group had higher preoperative mean LDL. Both groups did not show any significant change in the TC, HDL and TC/HDL ratio postoperatively. Postoperatively there was a significant reduction in FBS levels and WHR in both the groups. BMI reduced significantly in the obese group postoperatively. Dyslipidaemia was prevalent equally between both the groups.

Discussion

CAD is a leading cause of mortality and

morbidity among the non-communicable disease in developing countries like India. In the recent times the health care delivery in India

non-fatal cardiovascular events is often ignored by the healthcare professionals in many a institution. There are very few institutions that

VARIABLES	OBESITY (N= 27)			NO OBESITY N = 47		
	PREOP [#]	POSTOP [#]	p =*	PREOP [#]	POSTOP [#]	p =*
FBS	117.19+52.39	98.89+23.26	0.021	105.35+31.85	96.76+17.68	0.045
TCL	172.46+37.27	159.62+42.21	0.274	173.35+43.58	159.41+41.74	0.075
LDL	94.26+22.82	92.01+29.42	0.754	102.58+39.27	92.11+31.67	0.139
HDL	43.54+7.03	42.38+8.26	0.608	43.71+7.1	43.04+7.94	0.598
TGL	178.12+96.57	125.08+57.42	0.003	157.36+77.56	140.16+57.65	0.160
LDL / HDL	2.15+0.31	2.14+0.45	0.934	2.32+0.73	2.1+0.48	0.093
TCL / HDL	3.94+0.42	3.73+0.52	0.128	3.94+0.6	3.68+0.57	0.300
W / H	0.97+0.47	0.94+0.6	0.012	0.96+0.04	0.92+0.04	0.000
BMI	27.67+1.86	25.67+1.98	0.000	22.94+1.74	22.62+1.85	0.079

TABLE 5: COMPARISON BETWEEN OBESE AND NON-OBESE PATIENTS

* p Value at 95% confidence level using paired t-Test

#MEAN + SD

has been significantly advanced with many tertiary level health care institutions offering effective therapeutic management for patients with CAD. There is a steady rise in the figures of CABG surgery and Percutaneous Transluminal Coronary Angioplasty (PTCA) carried out in this country. Greater awareness through the media educational programmes and adopting the current accepted standards of treatment has greatly contributed to the patients undergoing revascularization procedures. Notwithstanding these facts the importance of pursuing an effective CR program to adopt favourable or desirable therapeutic lifestyle changes (TLC) by patients with CAD with a view to rehabilitate and prevent future fatal /

offer an effective CR program to those suffering from CAD. The culturally diverse social scenario in India and lack of motivation has been hurdles in delivering CR programs and its effective performance.

Within the limitations prevalent ubiquitously in the culturally diverse setting of India, we could conduct a comprehensively structured CR program in south Indian patients undergoing CABG surgery. A concept that involved no investment and that could be practiced in out-of the hospital or community level was adopted. The DREAM program was furthered to this effect.

In this study cohort, vast majority of subjects undergoing CABG surgery were males.

This probably is a reflection of the lack of motivation among the womenfolk with CAD to accept to undergo surgical revascularization. It is evident that women with CAD require to be offered a comprehensive CR program of which motivation leading to adoption of desirable attitudes ensuring to undergo revascularization and subsequent greater fitness level and healthy state of staying wholly well. Prevalence of dyslipidaemia is high to the order of 66% among the cohort studied indicating higher susceptibility among the south Indian patients' with CAD. Asian Indians have been known to run greater risk of CAD due to prevalence of dyslipidaemia that promotes acceleration of atherosclerosis. Majority of subjects undergoing CABG surgery were in the age group 40 – 60 yrs. CR through DREAM concept would be a very effective platform to help them adopt healthy lifestyle practices directed at primary and secondary prevention level.

Prevalence of diabetes is well known in India that is projected to be the global diabetic capital. 25% of the cohorts were diabetic and specific measures through CR directed at balanced diet, appropriate physical activity schedule help them to maintain well-being. Smoking was the least prevalent risk factor noted and shows a definite encouraging trend to not to adopt tobacco smoking. Family history of CAD ranked second highest prevalent CAD risk factor that emphasize the adoption of TLC should be initiated very early in the life of such high risk subject on identification. Obesity is prevalent among 36% of the subjects pointing to the poor lifestyle habit cultivation. A comprehensive CR that is DREAM is an effective method to address all these issues and is evident in the adherence of the study cohort in our programme. Nearly 84% of subjects attended the follow-up at the CR unit reflecting a great deal of motivation and attitude adoption

towards well-being despite limitation in Indian setup.

The results of CR indicate a definite favourable change in the various risk profile of the subjects considered. There was overall achievement of the target goals aimed. The facts that this could be achieved at 12 weeks follow-up program following CABG surgery proves the importance of a sustained comprehensive CR programme in a structured manner. This is a highly emerging trend.

The diabetic subset of patients showed a remarkably significant reduction in the FBS levels and anthropometric indices namely WHR ratio and BMI by following the TLC that included desirable dietary practices, regular physical activity program and behavioral patterns. The mean level of TC in this group at the end of 12 weeks program was very close to the target value of 150 mg/dL and attained a favourable TC/HDL ratio levels. The non-significant trend of reduction in the lipid fractions noted among the non-diabetics could be possible explained by non-usage of statins.

The obese patients had significant reduction in their BMI at 12 weeks of following the CR program. The study also showed a significant and desirable change in the central obesity pattern among the obese and non-obese subjects. Therefore specific measures should be considered to identify those with central obesity as compared to generally obese subjects. A larger study looking into the above comparative subjects would throw more information on the cardiovascular-dysmetabolic syndrome that is seen among centrally obese persons.

Acceptance and practice of the DREAM concept of CR is evident in the study where the study cohort had a mean number of visits of over 4 (84% of the cohort), Fig.1. Greater the adherence to the program, greater the beneficial effects on the various metabolic indices,

physical conditioning state and anthropometric values. Significantly lower RPP at rest observed in the most frequent attendees reflect their good physical conditioning state achieved through rehabilitation. All the patients attained a good effort tolerance and a high level of workload – more than 11 METS – that could be achieved only through regular motivation, desirable attitude and behavioral changes through rehabilitative efforts.

As longevity improves with proper health care delivery, measures through CR with comprehensive community based methods should be emphasized to direct to achieve well-being of the whole community. Need to remain healthy should be understood in its presence and not during its absence. This is possible only by regular practice of TLC, which can be effectively delivered through the DREAM concept of CR. The greatest hurdle in this context is certainly an impermeable mind to perceive the importance of TLC to stay healthy throughout.

Limitations of the study were the size of the cohort. However the authors conducted the study on a pilot feasibility basis. Also there was a lack of pharmacological data collected preoperatively. It is planned to study a larger cohort involving patients across the geographical confines and to know the adherence to a community based CR program in reality. The present cohort comprised only of patients from the city of Chennai where the study was conducted.

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