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Research Brief

Feasibility of an exercise-based cardiac rehabilitation algorithm in patients following percutaneous coronary intervention for acute coronary syndrome

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ABSTRACT

Cardiac rehabilitation (CR) is underutilised across the world and India. The use of simple algorithms is one way to facilitate CR, however, these algorithms need to be feasible to use across low resource settings. The objectives were to assess the feasibility of a CR algorithm following percutaneous coronary intervention (PCI) for acute coronary syndrome (ACS). A single group, pre-post study on 50 participants undergoing PCI for ACS found significant improvement in various feasibility metrics at discharge and 30-days, with no major adverse events. The proposed CR algorithm was safe and feasible for low and moderate risk patients with ACS undergoing PCI.

1. Introduction

The rising trend of cardiovascular diseases (CVD) in India accounts for about a fifth of the world's cardiovascular deaths, with fatality rates at 17%.[1–3] Despite this, there is an inverse relation between the existing disease burden and the availability and utilization of cardiac rehabilitation (CR), i.e., CR density not just around the world but also in India.[2–4] In India, the CR density (i.e., number of incident ischemic heart disease cases per year per CR spot) was 360, which ranked it at 71/86 globally.[3] Thus, in a country like India where both resources and CR centers are limited, assessing feasibility and outcomes of such low-cost models are paramount and crucial to the implementation to clinical practice.

To augment CR availability and utilisation, a low-cost model has recently been formulated for patients with acute coronary syndrome (ACS) undergoing percutaneous coronary intervention (PCI) (Supplementary Fig. 1).[5] This algorithm was formulated based on the available guidelines, established evidence and the active input of a multi-disciplinary team of cardiac rehabilitation professionals. Furthermore, it has not been tested in large scientific studies. Considering the poor CR density in India and simplicity of the CR algorithm, this study was designed to assess the feasibility of this low-resource CR algorithm for patients with ACS undergoing PCI.

2. Methods

A single group, pre-post study was carried out in a tertiary care, University teaching hospital in South India following Institutional Ethics Committee approval (IEC no. 169/2018) and trial registration (CTRI/2018/07/014,713).

2.1. Study population

50 patients were recruited through purposive sampling, between August 2018 and February 2019. Patients were screened for inclusion (primary and/or interval PCI for ACS) and excluded if clinically and haemodynamically unstable, with symptoms of heart failure and/or neuromuscular conditions limiting rehabilitation. Written informed consent was obtained prior to enrolment.

2.2. Procedure

Information of eligible participants were obtained, and the CR algorithm was administered by the physiotherapist (Supplemental Fig. 1).[5] During the delivery of the algorithm, treatment time and level achieved on the algorithm were recorded. At the time of

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discharge, choice of CR was offered (i.e., supervised or home-based) as recommended.[5] Weekly telephonic follow-up for a month following discharge was also implemented.

This algorithm was assessed using the feasibility metrics and its sub-components, measured at various time points (Supplemental Table 1).[6] At 30-day follow up, major adverse cardiovascular events (re-hospitalisation, angina and mortality) and scientific metrics were re-assessed.

2.3. Statistical analysis

The results were analysed using Statistical Package for the Social Sciences (SPSS) version 16.0: Descriptive statistics were used to report demographic variables and the metrics except for scientific metrics, which was analysed using the Student's *t*-test. Repeated measures of analysis of variance was used to analyze the differences in treatment time. Exploratory analysis using binary logistic regression with backward stepwise reduction was performed to identify factors predicting cardiac self-efficacy at 30 days. Statistical significance was considered when $p \leq 0.05$.

3. Results

Of 64 referred participants, 50 were administered exercise-based CR using the algorithm with 42opting for home-based CR (Supplemental Fig. 2) at discharge and 35 were followed-up and analysed at 30 days (Supplemental Fig. 3). Characteristics of all the participants and between those attending and not attending home based CR are provided in Table 1 and Supplemental Table 2, respectively. Characteristics of the non-attendees were similar in all aspects except for age and risk categorisation.

Table 1 also describes process and resource metrics; projecting the refusal rate, completion rate and drop-out rate (utilisation of CR) and management metrics reflecting its safety. Six sessions of phase 1 CR saw a significant reduction in treatment time ($p < 0.001$, $\eta^2 = 0.782$).

Scientific metrics showed clinically and statistically significant functional and psychological improvements except for cardiac self-efficacy which showed a significant reduction (Table 1), of moderate effect size (0.559–1.13). Further exploration did not identify any significant factors predicting self-efficacy at 30 days.

4. Discussion

This algorithm is feasible, meeting three out the four pre-defined feasibility criteria: refusal rate = 25%, time = 30 min for each session, adverse events = 1% and significant improvements in scientific metrics. The CR algorithm was safe, effective and achievable (100% completion of the algorithm) with 78.12% acceptance amongst low and moderate risk PCI group.

Table 1
Demographic characteristics and feasibility metrics.

Description	Value ($n = 50$)				
Gender Male, n (%): Female, n (%)	38(76):12 (24)				
Age in years, Mean ± SD	59.1 ± 11.1				
ST elevation myocardial infarction, n (%)	34 (68)				
Non-ST elevation myocardial infarction, n (%)	16 (32)				
AACVPR risk stratification					
Low risk, n (%)	28 (56)				
Moderate risk, n (%)	22 (44)				
TIMI risk score, Mean ± SD	2.24 ± 1.17				
Left Ventricular Ejection Fraction in %, Mean ± SD	54.68 ± 10.13				
Dyspnea on initial day, n (%)	5 (10)				
Angina on initial day, n (%)	2 (4)				
Re-admissions, n (%)	2 (4)				
Medications					
Anti-platelet, n (%)	50 (100)				
Anti-platelet aggregator, n (%)	50 (100)				
Statins, n (%)	50 (100)				
Nitrates, n (%)	20 (40)				
Beta-blocker, n (%)	20 (40)				
Alpha and beta blocker, n (%)	4 (8)				
Feasibility metrics					
Metrics	Values				
Process	Refusal rate, % (n) = 14% (7/50)				
Resource	Drop-out rate, %, (n)	16% (8/50)			
	Length of stay in days, Mean ± SD	5.18 ± 2.2			
	Reduction in time of treatment in minutes, Mean ± SD	9.5 ± 4.8			
Management	At discharge		At 30 days		
	Adverse events = 0		Re-hospitalisation = 0		
	Mortality = 0		Mortality = 0		
Scientific	Discharge ($n = 49$), Mean ± SD	30 days follow up ($n = 40$), Mean ± SD	Difference	Cohen's d	*p*-value
6MWD	373.12 ± 98.89	415.63 ± 100.47[a]	42.51 ± 28.02	−1.25	0.001
TSK	44.9 ± 12.71	35.25 ± 11.78	9.65 ± 6.573	1.313	0.001
CDS	78.82 ± 17.6	62.95 ± 16.79	20.1 ± 27.29	0.659	0.001
CSE	40.75 ± 9.75	37.55 ± 8.89	3.2 ± 5.1	0.559	0.001
Algorithm characterisitics					
level 1 completion, % (n)	12, (6/50)				
level 2 completion without level 1, % (n)	88, (44/50)				
level 3 completion without stairs, % (n)	64, (32/50)				
level 3 completion with stairs, % (n)	36, (18/50)				
overall completion, % (n)	100, (50/50)				

[a] Only 35 completed the 30-day 6-min walk test.

Table 2
Proposed sub-division of Level 3 of the algorithm.

Level	Exercise	Frequency	Dosage
level 3a	Progress active exercises, sitting time and walking distance	1–2 times/day	Intensity: RPE = 11–12/20 HR > 20bpm Time: 5–10 min
level 3b	Progress active exercises and to stair climbing, maintain walking distance	1–2times/day	Intensity: RPE = 12–13/20 Time: 5–10 min

4.1. Process metrics

The individual variation in attaining level 3could be related to the length of hospital stay and clinical condition. Therefore, subdividing level 3 into two components: 3a (without stair climbing) and 3 b (with stair climbing) could be considered (Table 2).

In the present study, the refusal rate was lower than that reported for a subset of PCI patients 48.6% (18/37).[8] The refusal rate in our study truly reflects the patient's willingness to participate in an exercise-based CR, as the physician played a neutral role in the decision making of the participants.

Patients are important stakeholders of any intervention and are key players who impact its implementation.[9] Therefore, to understand the reasons behind refusal to participate in CR, the patients ($n = 14$) were asked to state the reasons as well. Among those not willing to enrol into the study, five were not interested and four of them felt they were independent enough and did not require any exercise. Furthermore, they thought it could hinder their discharge ($n = 5/12$).

4.2. Resource and management metrics

The length of hospital stay and the safety of CR were similar to other studies.[9,10] Significant reduction in treatment time could be attributed to the low risk status and better cardiac function which enabled them to exercise with limited supervision. Patient compliance and volume of exercise were, however, not assessed.

The drop-out rate in our study was lower than that observed by Mikkelsen T et al.[7] [21% (37/176)] and by Vos D et al [40.5% (15/37)].[8] The non-attendees in this study were similar in all aspects except that they were older and in the lower risk category, in comparison with those who attended CR (Supplemental Table 2) which is in contrast to the study by Mikkelsen et al.[7] where they were mainly in a younger age group. The reason for this finding could be attributed to the fact that the participants in our study were of lower risk, in spite of being older, which could have promoted a faster attainment of independence when compared to the group of attendees.

4.3. Scientific metrics at discharge

Participants presented with lower 6MWD than those with ACS(373.12 m v/s 470 m).[11] The psychological findings were similar to other studies, except for kinesiophobia, which was higher in our study.[12–14] However, the varying time points of kinesiophobia assessment (i.e., 6 months after diagnosis v/s 3–5 days after diagnosis), suggests that chronicity of the disease could influence this finding.[12]

4.4. Scientific metrics at 30-days

The functional and psychological benefits were similar to previous studies, despite the short duration of phase 2 CR.[11–15] Except self-efficacy, which was contrary to the study that assessed cardiac self-efficacy in CAD population.[14] This could be attributed to the over-protective behaviour of relatives in the Indian context, previous physical activity behaviour and timing of assessment.[14] Quality of life saw an improvement across all the domains, which was higher than those reported by Manjunath K et al.[15]

This is one of the first studies to assess the feasibility of this low cost and contextually relevant CR algorithm. Nevertheless, it is not without limitations. Lack of blinding, the short duration of phase 2 CR, lack of detailed echocardiographic evaluations and treatment, are some of them. Despite these, the study opens possibilities for future research focusing on long term follow up, addition of control groups and recruitment of high-risk patients. In addition, effects of technology driven CR for home-based delivery could be assessed in future trials.[16]

To conclude, this CR algorithm is feasible among low and moderate -risk ACS patients undergoing PCI. A minor modification to the existing algorithm could facilitate better delivery of exercise-based CR while in-hospital.

Key message

- This low cost cardiac rehabilitation algorithm is feasible among those with ACS of low to moderate risk undergoing PCI in a low resource setting, with an additional benefit of reduction in kinesiophobia.

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None.

Conflict of interest

None.

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Appendix A. Supplementary data

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