Recent Strategies for Cardiac Rehabilitation in Post-Myocardial Infarction Patients: A Narrative Review

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ABSTRACT

Myocardial Infarction (MI) is a severe cardiac crisis that can result in significant morbidity and death. ST segment Elevated Myocardial Infarction (STEMI) is irreparable myocardial damage caused by persistent ischaemia, and while the adage "time is muscle" remains true, rapid and prompt detection of MI continues to be a key concern. Cardiac Rehabilitation (CR) is the most significant evidence-based intervention for secondary prevention following STEMI. However, only a small proportion of patients have access to a cardiovascular recovery programme. Recent research implies that exercise-based CR provides significant benefits to patients with cardiovascular disease, including a lower risk of MI, a likely slight decline in all causes of mortality, a massive reduction in all-cause hospitalisation, along with associated medical costs, and enhanced Health-Related Quality of Life (HRQoL) upto a year of follow-up. Adapting rehabilitation programmes to existing abilities based on experience in the field of activity is becoming a major solution in the current CR training programme selection. The effectiveness of both centre-based and home-based therapy is proven. Telerehabilitation and home-based rehabilitation strategies have gained much importance during the Coronavirus Disease-2019 (COVID-19) pandemic. Further research is needed to standardise the treatment quality for patients with home-based CR.

Keywords: Coronavirus disease-2019, Mobile application, Myocardial infarction, Physiotherapy, Telerehabilitation

INTRODUCTION

The MI is a severe cardiac crisis that can result in significant morbidity and death. STEMI is irreparable myocardial damage caused by persistent ischaemia, and while the adage "time is muscle" remains true, rapid and prompt detection of MI continues to be a key concern [1]. This illness is characterised by acute coronary syndrome induced by bouts of plaque ulceration, fissuration, or rupture, which results in the generation of thrombogenic material and the development of intravascular thrombus. Acute coronary syndrome, sometimes referred to as Type 1 MI, is characterised by unstable angina, STEMI, and Non-ST segment Elevated Myocardial Infarction (NSTEMI) [2]. The exclusion and inclusion of elevated ST-segment on the Electrocardiogram (ECG) distinguish two primary clinical spectrums of STEMI and NSTEMI [3]. Acute Myocardial Infarction (AMI) is a devastating condition, especially when it affects children. Despite significant advancements in prognosis over the past 10 years, AMI continues to be the most common cause of morbidity and death globally [4]. It is linked to a high psychological impact and financial constraints for the sufferer and their family [5]. Familial hypercholesterolemia, cigarette smoking, arterial hypertension, diabetes mellitus, or chronic renal disease are also risk factors for AMI, particularly in younger individuals. STEMI is more common in young individuals with AMI in clinical studies.

Severe coronary artery narrowing is more common in the Left Anterior Descending artery (LAD) compared to other arteries in AMI. The majority of patients with AMI experience coronary atherosclerotic plaque rupture, thrombosis, myocardial ischaemia necrosis, arrhythmia, heart failure, and even shock, all of which represent a significant risk to the patient's life and safety [6]. Type 1 MI occurs as a result of an acute plaque rupture/erosion event, which has also been seen in the context of other viral infections, whereas, type 2 MI occurs as a result of "demand ischaemia" caused by an oxygen demand/supply mismatch caused by stress factors such as hypoxia, hypoperfusion, and tachycardia [7].

Many attempts are made to avoid coronary artery disease in the first place, and quick diagnostic tools are employed. A network of

invasive cardiology centres is being established to provide the best screening and therapeutic choices for the entire community [5]. In 2020, COVID-19 was the third leading cause of death with an estimated 345,323 deaths in the USA. Perhaps more than any other communicable disease, COVID-19 has captivated the cardiology community due to its apparent links with cardiovascular disease. Both types of MIs have been reported in COVID-19 [7].

Cardiac Rehabilitation (CR)

CR is the most significant evidence-based intervention for secondary prevention following STEMI; however, only a small proportion of patients have access to a cardiovascular recovery programme. It is critical to emphasise the necessity of CR involvement for all post-MI individuals, especially those from low-income families [8]. Rehabilitation is an interdisciplinary, systematic, and customised method of delivering appropriate medical, lifestyle, and psychological therapy to individuals suffering from a range of cardiovascular conditions [9].

CR exercises are an important part of the secondary prevention of Coronary Artery Disease (CAD). Scientific and reasonable CR exercise can improve vascular endothelial function, maintain the stability of coronary artery plaque, and promote the establishment of collateral circulation, thus reducing mortality and improving cardiac function and the Quality of Life (QoL) of patients [6]. CR is often performed as a three to four-week multimodal intensive course to positively influence the disease's medical, physical, mental, and socioeconomic components [10]. Anderson L et al.,conducted a research, that concluded exercise-based CR provides significant benefits to patients with cardiovascular disease, including a lower risk of MI, a likely slight decline in all causes of mortality, a massive reduction in all-cause hospitalisation, along with associated medical costs, and enhanced HRQoL upto a year of follow-up [11]. The outcomes may include a lower risk of cardiovascular events and MI over a prolonged period [12].

Cardiac Rehabilitation (CR) Strategies

Centre and community based rehabilitation: Adapting rehabilitation programmes to existing abilities based on experience in the field

of activity is becoming a major solution in the current CR training programme selection. Indoor cycling is a type of aerobic interval training that is comparable to the typical exercise prescribed in the second stage of recovery but with a slightly altered course. Indoor cycling training, which is employed in fitness Centres, and standard endurance training, which is employed from the second stage of CR, have many similarities. In individuals who have had an MI, both indoor cycling training and standard training (aerobic, resistive, flexibility exercises) have a comparable impact on improving exercise tolerance, changing hemodynamic markers of the left ventricle, and improving lipid metabolism. In CR, indoor cycling exercise can be used instead of traditional endurance training [13]. For patients with coronary heart disease, Centre-based CR lowers recurrent ischemic episodes, improves HRQoL, and improves long-term outcomes as mentioned in a study [14]. Only about a quarter of outpatients participate in community-based physical therapy programmes and services; 30% to 40% quit after six months, and upto 50% quit after a year. Xiao M et al., found that, community-based physical therapy lowered Major Adverse Cardiovascular Events (MACE) risk and increased cardiovascular function and physical endurance in individuals who had Percutaneous Coronary Intervention (PCI) after an AMI [15]. However, most patients receive rehabilitation while in the facility, and only for a brief period. Patients may benefit from community-based strategies to help them retain the benefits of in-hospital rehabilitation [15].

Home-based approaches:

A. Exercise intervention: Given the paucity of CR programmes in India and the low acceptance globally, there is an urgent need for developing alternative CR approaches that are economical and may provide options to underprivileged populations [16]. Hence, a study was conducted to evaluate how yoga-based CR impacts major cardiovascular events and self-perceived health. Yoga is a famous Indian mind-body exercise that has spread across the globe. It is a combination of physical functioning and psychological functioning. Physical functioning includes physical exercise with breathing. Psychological functioning includes meditation. Yoga-CaRe enhanced self-reported health and return to pre-infarct activities after AMI. When traditional CR is unavailable or unsuitable for specific individuals, Yoga-CaRe could be an alternative. The possible advantages of the Yoga-CaRe programme could be mainly attributed to meeting the primary objectives of traditional CR: providing a structured programme of exercise and support to maximise physical and psychosocial functioning, as well as improving health behaviors to slow the progression of the disease [16].

B. Web-based application and telerehabilitation: Many parts of healthcare have been transformed through the use of mobile and wearable technology for pulse rate and activity tracking, and CR is a potential area for utilising real-time monitoring to enhance cardiovascular outcomes. The use of Home-Based Cardiac Rehabilitation (HBCR) is undoubtedly one of the most urgently required innovative approaches for increasing active involvement. HBCR programmes have been improved due to the latest developments in information and communication technology. Vital signs and physical activity can be effectively controlled with the use of wearable technology and portable medical sensors [17]. Chaari M et al., conducted research that has provided a multi-platform Human Activity Recognition (HAR) based smartphone app for HBCR using an application that enables clinicians to track specific individuals at their homes using the Hexoskin intelligent-textile shirt [17]. Walking, jogging, falling right, left, backward and forward, climbing stairs, descending stairs, sitting, and lying all generate acceleration signals that are recorded by the shirt. After that, this data is delivered to the application for analysis. This can be used for monitoring during home-based rehabilitation and can help doctors monitor patients' activity by creating an interactive dashboard that provides feedback [17].

The feasibility of providing cardiac telerehabilitation at home to AMI survivors via a health watch-based programme and telephone counseling sessions was demonstrated in one study. The usability

and adherence to the usage of health watches, exercise advice, and counseling sessions were found to be excellent. Delivery of CR using contemporary telecommunication and smart device technologies may reduce logistical and financial barriers associated with CR by facilitating CR in the home. The ability to perform CR at home may increase participation while providing comparable outcomes for patient HRQoL, exercise capacity, and mortality [18].

The impact of initial home-based CR exercise on the prognosis of patients with AMI following PCI is investigated by a group of researchers. They selected a group of patients that underwent PCI after AMI and divided them into two groups: "Group A and Group B". Standard exercise rehabilitation training was given to Group A, whereas early home-based CR instruction was given to Group B. Early home-based CR in patients with AMI following PCI can improve functional recovery, lower the risk of postoperative complications, and increase cardiac antioxidant capacity, exercise tolerance, and QoL [6]. A 24-week dual-phase Smartphone CR, Assisted self-Management (SCRAM) strategy had been adopted in a study. If the SCRAM programme is found to be cost-effective, it can be advocated on a national or even worldwide level as a complementing alternative CR delivery model that may satisfy the requirements of many imdividuals, who are unwilling or unable to engage in typical Centre-based CR programmes. The findings will help policymakers, healthcare administrators, and other providers of health services make informed judgments about the SCRAM programme's continued usage or potential future deployment [14].

Artificial Intelligence (AI) is a branch of computer science that aims to replicate human cognitive processes, learning ability, and information storage. AI is divided into two major subfields: Machine Learning (ML) and cognitive computing. Incorporating AI may improve the uptake and delivery of cardiac telerehabilitation [19]. The use of digital health treatments, such as telemedicine, web-based techniques, mobile applications, and monitoring devices, has the potential to encourage autonomy and self-management. With the introduction of modern ML tools and algorithms, a new class of smart digital health treatments can be created. ML has been widely used in various medical fields, including diabetes, cancer, cardiology, and mental health are a few of the medical fields, whereit has been used [20].

Paruchuri K et al., designed an application to handle the inpatient-outpatient transition following PCI to increase CR enrollment [21]. Their objectives were to determine the feasibility of deploying a smartphone application during inpatient hospitalisation and to examine the application's performance in increasing CR participation, as well as, the short-term safety of engaging with third-party healthcare consultants compared to historical controls. Mobile health platforms were previously considered revolutionary care solutions and have recently been proposed to minimise transmission of Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2). Virtual techniques can enhance access to care and make lifestyle changes easier [21]. Among post-MI patients receiving treatment in an organised CR programme, text message reminders significantly improved adherence to medication and exercise. This system is a simple and scalable way to ensure the consistent use of evidence-based cardiovascular medicines [22]. Research on the cardiac telerehabilitation platform includes an Android-based application for patients and web-based monitoring for rehabilitation instructors. A cardiac telerehabilitation system is a useful tool for post-MI individuals who are unable to visit outpatient CR facilities due to various factors [23]. Using mobile technologies is a practical method to expand accessibility and personalise CR [24].

During the COVID-19 pandemic, hospitalisations for AMI significantly decreased, but death and complication rates increased. As a result, CR Institutions have been obligated to emphasise more on distant or virtual CR services [25]. A study has revealed that cardiac telerehabilitation sessions are associated with improvements in

cardiac patients' fitness levels, enhancements in their QoL, and a decrease in rehabilitation administrative costs [26]. COVID-19 has posed significant challenges in the implementation of CR, hindering patients' access to CR and creating difficulties for hospitals. However, it has also highlighted the role of CR in encouraging positive lifestyle changes that reduce the risk of atherosclerotic CVD and COVID-19-related illness and death. This has led to an increased acceptance of new technologies into routine clinical practice, as they may increase access to and engagement in exercise-based CR after the COVID-19 era. Several innovations have been introduced to ensure that patients can continue to benefit from CR even during the pandemic period, with telerehabilitation and mobile phone applications becoming mainstream practices. Telerehabilitation utilises information and communication technologies, such as smartphones or teleconferencing, to provide feedback, training, and consultation. It has transformed telerehabilitation from a rarely used intervention to the most useful intervention in the last two years [26].

CONCLUSION(S)

Cardiac rehabilitation is a technique that can help patients improve their cardiovascular health, provide a secondary intervention to patients diagnosed with myocardial infarction, and improve their QoL. The effectiveness of both centre-based and home-based therapy has been proven. Telerehabilitation and home-based rehabilitation strategies have gained much importance during the COVID-19 pandemic. Further research is needed to standardise the treatment quality for patients with home-based CR.

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