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Cardiac Magnetic Resonance [CMR] Versus Echo-Doppler Cardio Graphic Parameters for Myocardial Recovery Detection after Chronic Total Occlusion [CTO] Revascularization

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Abstract

Background and aim : Despite significant advances in the treatment of coronary artery disease [CAD], the condition remains the primary cause of morbidity and death globally. 15–20% of individuals with coronary artery disease [CAD] have chronic complete occlusion [CTO] of a coronary artery. The purpose of this study was to examine the usefulness of cardiac MR, TTE, Doppler Echocardiography, and speckle tracking echocardiography in identifying recovery in patients with CTO who benefited from revascularization following successful revascularization. Patients and Methods : Thirty patients with ischemic heart disease and coronary angiography-confirmed chronic complete blockage were included in this prospective, single-center observational research. Patients were exposed to a comprehensive history, current medicines, the angioplasty operation, echocardiography, two-dimensional echocardiography, myocardial strain evaluation, cardiovascular magnetic resonance imaging, and follow-up four months following PCI. Only GLS demonstrated a statistically significant improvement in myocardial recovery performance. Conclusion : CTO-PCI may successfully enhance LV function, as concluded.

Keywords: Cardiac Magnetic Resonance; Echo-Doppler; Cardiograph, Myocardial Recovery, Chronic Complete Occlusion.

1. Introduction

Approximately one-third of coronary angiograms performed on individuals with known or suspected coronary artery disease reveal the presence of one or more arteries with chronic complete occlusion [CTO] [1,2]. The benefits of PCI of a CTO are controversial for three primary reasons: first, PCI of a CTO is technically challenging for the interventional cardiologist, with a lower success rate than achieved in other coronary lesions; second, OAT [Occluded Artery Trial] demonstrated a lack of benefit of PCI versus medical therapy in patients with an occluded infarct-related artery; and third, PCI of a CTO is associated with a higher mortality rate [3].

Cardiac magnetic resonance [CMR] is a high-resolution noninvasive imaging technology that can evaluate regional and global left ventricular [LV] function, as well as identify the existence and severity of infarction and ischemia load [4].

It has been said that two-dimensional [2D] echocardiography is the optimal imaging technique for assessing global and localised ventricular function. However, typical evaluation of wall motion based on visual interpretation of endocardial excursion and myocardial thickness is qualitative, subjective, and experience-dependent [5].

Two-dimensional speckle tracking echocardiography [2D-STE] permits angle-independent measurement of myocardial strain and gives complete information on left ventricular [LV] myocardial contractility. Thus, 2DSTE is better in identifying minor contractility deteriorations [6].

2. Patients and methods

Twenty patients with ischemic heart disease and a coronary angiography diagnosis of chronic complete occlusion participated in this prospective, single-center observational research. The research was conducted between 2020 and 2021. After patients were given a thorough explanation of the goal and nature of the research, they gave their informed permission.

CTO is defined as an atherosclerotic total vascular occlusion with TIMI grade 0 flow inside the occluded segment and an anticipated occlusion period of 3 months [1].

Insufficient echocardiographic image quality, Atrial fibrillation, Per procedure myocardial infarction, and acute coronary syndrome during the follow-up period were exclusion criteria.

All research participants were exposed to the following conditions: Full medical history with a particular focus on: anthropometric data [age, gender], medical history: diabetes, hypertension, hypercholesterolemia, cigarette smoking, and prior myocardial infarction.

Current drugs include an antiplatelet agent, an ACE inhibitor, a beta blocker, and statins.

Angioplasty technique: Based on a history of acute chest discomfort, a prior myocardial infarction in the same target artery area, or the period between coronary angiography and percutaneous coronary intervention, all research patients had a native vessel blockage assessed to be at least three months in length. Each patient had either clinical angina or a positive ischemia investigation. Standard PCI and stent placement procedures were carried out. All of the angioplasty operations used drug-eluting stents of second generation. Heparin was provided to preserve an active clotting time greater than 250 seconds.

Echocardiography: According to the American Society of Echocardiography, a single investigator conducted an echocardiographic examination [ASE]. In accordance with the guidelines of the American Society of Echocardiography [2], echocardiography was conducted using a Philips IE33 ultrasound machine with an M4S transducer.

Prior to CTO PCI, a two-dimensional transthoracic echocardiographic and Doppler study assessment was conducted. Imaging was conducted using a 2.5MHz complete two-dimensional cardiac ultrasound device; LV dimensions were estimated using M-mode online from parasternal projections. Included in the measurements were interventricular septal thickness, posterior wall thickness, and LV end-systole and end-diastole diameter. During a breath hold, M-mode, 2-dimensional, and Doppler pictures were obtained. By tracing the LV end-systolic volume and end-diastolic volume in the apical 4- and 2-chamber views, the systolic function of the LV was evaluated. LV ejection fraction [LVEF] was determined using Simpson's biplane approach [3].

Using Simpson's biplane technique of discs, the left ventricular ejection fraction [LVEF] was determined. The 2D echocardiogram pictures [transmit/receive 1.9/4.0MHz] were acquired from several perspectives at frame rates ranging from 30 to 90 frames/s.

Offline, digital data were kept and examined. The LV endocardial surface was manually traced, and the speckle tracking width was modified to cover the entire LV wall thickness in order to obtain curves for the peak longitudinal strain of: The septum and lateral wall in the apical four-chamber view [4C-PLS]; The inferior and anterior walls in the apical two-chamber view [2C-PLS]; and the posterior and anterior septum in the apical three-chamber view [3C-PLS] [3C-PLS]. The global longitudinal systolic strain [GLS] of the left ventricle was determined by averaging the maximal systolic values of the six LV walls. One echocardiographer conducted all of the echocardiographic examinations.

Before CTO PCI, cardiovascular MRI tests were conducted utilising a 1.5-T MRI scanner [Achieva, Philips Medical Systems, Best, The Netherlands] with 32-channel cardiac coils. 15 minutes following intravenous administration of 0.20 mmol/kg gadolinium diethylenetriamine pentaacetic acid [Magnevist; Scher-ing AG, Berlin, Germany], 8-mm short-axis slices were collected using a gradient-echo sequence gated by an electrocardiogram. MRI pictures were uploaded to a computer and processed using specialised software [cmr42 version 3.3; Circle Cardiovascular Imaging, Inc., Calgary, Canada].

Follow-up: Four months following percutaneous coronary intervention, patients were monitored using clinical echocardiography and CMR without repeat LGE as stated.

Data were statistically characterised in terms of range, mean standard deviation [SD], median, frequencies [number of instances], and percentages, if applicable. The paired t-test was used to compare quantitative factors at baseline and follow-up in the study groups. Microsoft Excel 2016 [Microsoft Corporation, New York, United States] and SPSS [Statistical Package for the Social Science; SPSS Inc., Chicago, Illinois, United States] version 26 for Microsoft Windows were used for all statistical computations.

3. Results

Demographic data of the studied participants. **Table (1)**

Echocardiographic non-statistically significant improvement in LVEF, and non-statistically significant different improvement in LVEDV, non-statistically significant different improvement in LVESV ,non-statistically significant different improvement in E/A and non-statistically significant different improvement in E/e′. GLS The CMR parameters of the study patients at the baseline and 4 months follow-up after PCI. The CMR LVEF showed non-statistically significant improvement , non-statistically significant improvement in the CMR LVEDV , and non-statistically significant improvement in the CMR LVESV.

There was statistically significant improvement GLS values were shown at the follow-up examination [p<0.001].

Table (1) : Participants demographic data.

	%
Gender	
Male	73.3
Female	26.7
Comorbidities	
Hypertension	73.3
Diabetes mellitus	73.3
Dyslipidemia	73.3
Past smoker	
Yes	60
No	40
Previous MI	
Yes	26.7
No	73.3
Medications	
Antiplatelet drugs	100
B blockers	80
ACE inhibitors	73.3
Statins	73.3

4. Discussion

Chronic complete occlusions [CTO] of the coronary arteries are linked with severe clinical outcomes. The anticipated advantages of revascularization of a CTO are: [1] improved quality of life; [2] improved left ventricular [LV] function; [3] increased long-term survival; [4] increased tolerance to probable later coronary events; and [5] decreased risk of life-threatening arrhythmias [5].

The average age of the participants in this research was 52.7 6.7%. There was a preponderance of men. These results are congruent with what has been previously established, namely that CAD and, more specifically, CTO are more frequent among older men [6]. Blessing et al.[7] found comparable results, with mean ages of 62.3 10.5, 63 11, and 59.6 10.3 years, and male prevalence rates of 83%, 82%, and 72.5%, respectively.

Regarding comorbidities, 22 patients [73.3%] had hypertension, diabetes, and dyslipidemia. 18 patients [60%] were former smokers, and 8 patients [26.7%] had a history of MI. CTO has been attributed to immunologic and inflammatory marker overexpression [cytokines, leukocytes, C-reactive protein with high sensitivity], endothelial dysfunction, and cholesterol buildup. It often begins with the accumulation of smooth muscle cells in the intima, followed by the accumulation of macrophages in the intima, which leads to pathologic intimal thickening and development of lesions [6]. Hajar [8] identified dyslipidemia, hypertension, and diabetes mellitus as risk factors for developing CTO in addition to CAD, which is consistent with our findings. According to the most current research by Zhao et al. [9], people with combination diabetes had a 4,269% greater risk of illness. In addition, the research by Abdulah and Miro [12] identified prior myocardial infarction, current smoking, and diabetes as risk factors for CTO.

Concerning the echocardiographic data of the study patients at baseline and follow-up after PCI, the current research demonstrated changes in systolic and diastolic LV function, as reflected by LVEF, LVEDV, LVESV, E/A and E/e' ratios, respectively. Without statistical significance, though. Similar results were seen for the CMR parameres data. At the follow-up evaluation, only significantly higher GLS values were visible [p0.001].

In earlier studies reporting improvement in LV function after CTO revascularization, LV function was most often measured by the LV ejection fraction utilising ventriculography [13], 2D echocardiography [14], or cardiac magnetic resonance imaging [15]. In accordance with the present study, Romano et al. [14] demonstrated that 2D STE is a more accurate noninvasive method for quantifying LV function. They also confirmed the improvement in LV function after CTO PCI, with successful CTO revascularization resulting in a significant improvement in the

GLS. It is probable that LVEF represents the global function of the LV, but it cannot differentiate localised myocardial strain in various directions, nor can it indicate early heart disease damage.

5. Conclusion

CTO-PCI may significantly enhance LV performance. This research provides data supporting the clinical use of 2D-STE to detect early changes in LV function.

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