Effect of early cardiac rehabilitation in patients included in the Infarction Code strategy

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Abstract

Introduction: Early cardiac rehabilitation (ECR) implemented in the Infarction Code (IC) protocol is a strategy in the care of acute myocardial infarction. The purpose of this study was to identify the effect of ECR in IC-included patients. **Method:** Case-control study. Consecutive patients diagnosed with acute myocardial infarction and admitted to a cardiology hospital between February 2015 and June 2017 were included. Two groups were created: I and II, before and after IC and ECR. **Results:** We included 1141 patients, 220 in group I and 921 in group II, with an age of 62.64 ± 10.53 years; 80.9 % were males and 19.1 % females. The main risk factors for groups I and II were sedentariness, 92.7 % versus 77.8 %; dyslipidemia, 80.9 % versus 55.8 %; hypertension, 63.2 % versus 62 %; smoking, 66.8 % versus 59.2 %; and diabetes, 54.5 % versus 59.1 %. Rehabilitation was started earlier (1.8 ± 1.6 versus 4.2 ± 3.2) and the days spent in intensive therapy and hospitalization were fewer in group II (2.4 ± 2.2 versus 4.8 ± 4.1 and 8.6 ± 5.2 versus 12.3 ± 7.7 , $p < 0.0001$, respectively), as well as the days of disability (58.6 versus 67.7). **Conclusions:** IC and ECR are complementary strategies that allow an early discharge from intensive therapy and hospitalization, as well as better quality of life and fewer days of disability leave.

KEY WORDS: Early cardiac rehabilitation. Infarction code. Quality of life.

Introduction

In Mexico, cardiovascular diseases are the leading cause of death and one of the main causes of morbidity. They increasingly affect men and women of productive age, causing absenteeism, disability and occupational pension. In Mexico, the National Institute of Statistics and Geography reported 685,766 total deaths from all causes in 2016, out of which approximately 97,743 were due to ischemic heart disease.¹⁻³ In the National Registry of Acute Coronary Syndrome (RENASCA – *Registro Nacional de Síndrome Coronario Agudo*) of the Mexican Institute Social Security (IMSS – *Instituto Mexicano del Seguro Social*), the cost for ST-segment elevation acute myocardial

infarction with (STE-AMI) initial treatment was calculated to be approximately 260,284 Mexican pesos, without considering long-term costs. Several studies have shown that cardiac rehabilitation prevents the development and progression of heart disease.⁴

Timely diagnosis and treatment in ischemic heart disease are fundamental and affect its evolution, complications and short and long-term prognosis. It is essential to properly treat the patient during the so-called “golden hour” in order to reduce mortality and preserve the cardiac function: in patients treated at between zero and six hours there were 30/1000 deaths recorded in comparison with 20/1000 in those treated at between seven and 12 hours; the differences were recorded especially in the first two hours.⁵⁻⁸

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The IMSS emergency care protocol known as Infarction Code allowed to improve the reperfusion strategies and attention times in the Cardiology Hospital of the National Medical Center Siglo XXI, as well as in nine hospitals and two family medicine units, with an effective interdisciplinary communication and offering 24-hour service seven days a week; with this program, fewer early complications and deaths were reported.⁹

Forty years ago, patients with STE-AMI were candidates for a pension and physical activity was not prescribed. Currently, cardiac rehabilitation programs require a multidisciplinary team consisted of doctors, physiotherapists, nutritionists, psychologists and nurses, among other professionals.¹⁰ The purpose of regular cardiac rehabilitation is to avoid the prolonged rest syndrome and to initiate physical activity after a cardiovascular event, to control of cardiovascular risk factors, and to address psychological aspects, as well as to reintegrate the patient to his/her social and working life.¹¹⁻¹³

The expenditure disbursed by the IMSS for the item "diseases and maternity insurance" was 329,264 million pesos in 2017. Since 2010, cardiovascular and circulatory diseases are the leading cause of years of healthy life lost due to premature death and disability. They are also the main reason for outpatient visits and, in 2010, they were fourth place in emergency department visits.¹⁴ For this reason, cardiac rehabilitation programs have been developed, mainly aimed at primary and secondary prevention, with functional and symptomatic benefits for the patient. In Mexico, the number of centers with cardiac rehabilitation programs is reduced (less than 4.4 %) and they are only assigned 6.2 % of the gross domestic product in comparison with an average of 9.3 % in the world, as recorded by the Organization for Economic Cooperation and Development.¹⁵

Since 40 years ago, the Cardiology Hospital of IMSS National Medical Center Siglo XXI, has the Cardiac Rehabilitation Department, whose referral percentage is 15 %. Currently, cardiac rehabilitation has to start since the early hospitalization phase and continue after discharge with a program of physical exercise, risk factor control and education regarding the disease, guided by a multidisciplinary team. The proposal of our group is early cardiac rehabilitation (ECR), which requires enrollment and cardiac rehabilitation initiation since phase I first 24 hours, with follow-up from intensive coronary care unit (ICCU) admission and during two phases of outpatient cardiac rehabilitation and self-help. The Infarction Code

protocol and ECR are part of the *A Todo Corazón* IMSS program for the prevention and care of cardiovascular diseases. The purpose of this work is to identify the effect of ECR in patients included in the Infarction Code, with the results compared with those obtained in patients not included in the program, in whom regular cardiac rehabilitation was provided.

Method

Through a case-control study, patients of either gender, between 20 and 95 years of age, with ejection fraction higher than 20 %, who were admitted to the Cardiology Hospital of the National Medical Center Siglo XXI, Mexico City, with a STE-AMI diagnosis according to the American College of Cardiology, American Heart Association and European Society of Cardiology criteria were included.¹⁶ Group I comprised patients diagnosed with STE-AMI and treated before February 2015, prior to Infarction Code implementation, and included in the regular cardiac rehabilitation program. Group II included patients diagnosed with STE-AMI in whom the Infarction Code protocol was followed and ECR was implemented. Patients with acute coronary syndrome without ST-segment elevation, severe aortic stenosis, heart failure, unstable angina, dissecting aneurysm of the aorta, uncontrolled ventricular arrhythmias, systemic or pulmonary embolism and acute infectious diseases were excluded. All patients signed an informed consent to participate in cardiac rehabilitation and in the study.

A recruitment sheet was used to analyze the data obtained from medical records. ECR includes three phases:

- Phase I, starting at between 24 to 48 hours in the ICCU. Mobilizations and stretches were performed, as well as ambulation during hospitalization (functional capacity, 1 to 3.5 metabolic equivalents [METs]).
- Phase II, after hospital discharge; it includes evaluation, stratification, physical exercise prescription, education for risk factors modification and reintegration to work activities (functional capacity, 3.5 to 10 METs).

Phase III, extra-institutional group physical activity (functional capacity, > 10 METs).

The dependent variables were intensive care unit days of stay, total hospitalization days, days of temporary disability and quality of life as determined by the Velasco Del Barrio questionnaire for patients with ischemic pathology and validated into Spanish, which

consists of 40 items grouped in nine areas: health, sleep/rest, emotional behavior, future projects, mobility, social relations, alertness behavior, communication and leisure/work.^{17,18}

Quantitative variables statistical analysis was carried out by obtaining central tendency and dispersion measures. Student's t-test was used for inferential statistics, and for qualitative variables, the chi-square test. A p-value < 0.05 was regarded as a significant difference. The SPSS statistical program, version 24, was used.

Results

A sample of 1141 patients was studied, 220 patients in group I and 921 in group II; 80.9 % were males and 19.1 % females. Total enrolled patients average age was 62.6 ± 10.5 years. Lower infarction was recorded in 48 %, anterior extensive infarction in 33.3 %, antero-septal in 16.8 % and lateral in 2 %. Anthropometric characteristics such as weight, body mass index and initial and final waist circumference are shown in Table 1. Main occupations were general employee (44 %) and administrative employee (22.6 %). Risk factors between study groups were less common in group II (Table 1).

Time to cardiac rehabilitation initiation was shorter in group II (2.41 days, $p < 0.0001$), as well as ICCU length of stay in (2.46 days, $p < 0.0001$) and hospitalization time (1.21 days, $p = 0.002$). Total hospitalization days in group II were decreased (3.64, $p < 0.0001$); we found fewer disability days in group II, 58.6 versus 67.7 days ($p < 0.0001$) (Table 2). Finally, group II showed a significant improvement in quality of life deficit (Velasco Del Barrio questionnaire)¹⁷ (Figure 1).

Discussion

Early management of the patient with acute myocardial infarction, with intervention in the acute phase aimed not only at physical activity initiation but also at patient education regarding the knowledge of his/her disease and the importance of cardiovascular risk factors control, achieves faster social and occupational reintegration and reduces care and re-hospitalization costs.

Infarction Code is a recent strategy in Mexico that includes monitoring in different departments within the intra-hospital treatment process, in addition to cardiac rehabilitation techniques and early management, intended to maximize the beneficial effect of the implemented measures.

Table 1. Characteristics of the population included in early and regular cardiac rehabilitation

Variable	Group I (n = 220)	Group II (n = 921)	p*
	Mean $\pm$ SD	Mean $\pm$ SD	
Age (years)	63 $\pm$ 10.8	63 $\pm$ 10.1	NS
Initial weight (kg)	72.4 $\pm$ 9.7	73.53 $\pm$ 12.2	NS
Final weight (kg)	71.8 $\pm$ 9.7	72.29 $\pm$ 11.9	NS
Initial waist (cm)	96.4 $\pm$ 8.0	96.59 $\pm$ 11.4	NS
Final waist (cm)	95.9 $\pm$ 9.3	93.84 $\pm$ 15.7	NS
Initial BMI (kg/height in m ²)	27.1 $\pm$ 3.2	27.34 $\pm$ 3.8	NS
Final BMI (kg/height in m ²)	26.7 $\pm$ 3.6	26.92 $\pm$ 3.7	NS
LVEF (%)	46.8 $\pm$ 9.4	46.06 $\pm$ 9.9	NS
	%	%	
Diabetes mellitus	54.5	59.1	NS
Systemic arterial hypertension	63.2	62	NS
Smoking	66.8	59.2	0.031
Sedentariness	92.7	77.8	< 0.0001
Dyslipidemia	80.9	55.8	< 0.0001
Obesity	19.1	27.3	0.011
Overweight	58.6	47.9	0.025
Depression	3.2	2.8	NS
Disease by number of vessels lesion			
I	69	47.7	< 0.0001
II	11.5	23.2	
III	19.5	29.1	
Risk stratification according to AACVPR			
Low	57.5	41.3	< 0.0001
Moderate	15.1	24.1	
High	27.4	34.6	

Group I = without early cardiac rehabilitation (prior to Infarction Code).

Group II = with early cardiac rehabilitation (Infarction Code).

*Significance by Chi-square.

*Student's t-test.

SD = standard deviation, BMI=body mass index, LVEF = left ventricle ejection fraction, NS = not significant, AACVPR = American Association of Cardiovascular and Pulmonary Rehabilitation.

In the study population, the male gender was more common (in both groups) and average age was 62.9 years, similar to Borrayo et al.⁹ findings, who also describe a population at higher risk. When comparing the groups, weight, waist circumference and body mass index decreases were observed in group II at the end of the program, although they were minimal and non-significant. Supervision of weekly energy expenditure per patient for a significant weight decrease

Table 2. Impact of early cardiac rehabilitation in patients with STE-AMI

Indicators	Group I (n = 220)	Group II (n = 921)	p
Days to start phase I	4.2 ± 3.2	1.8 ± 12.4 ± 2.2.6	< 0.0001*
Days of ICCU stay	4.8 ± 4.1		< 0.0001*
Hospitalization days	7.4 ± 5.6	6.2 ± 4.3	0.002*
Total in-hospital days	12.3 ± 7.7	8.6 ± 5.2	< 0.0001*
Days from TWD to phase II discharge	67.7 ± 19.1	58.61 ± 13.4	< 0.0001*

Group I = without early cardiac rehabilitation (prior to Infarction Code).

Group II = with early cardiac rehabilitation (Infarction Code).

*Student's t-test for independent samples.

STE-AMI = ST segment elevation acute myocardial infarction, ICCU = intensive coronary care unit, TWD = temporary work disability.

Figure 1. Quality of life according to the Velasco Del Barrio questionnaire. The larger percentage of patients with mild and moderate deficit in group II in comparison with group I, translates into an improvement at the end of early cardiac rehabilitation.

and hence a substantial improvement is an aspect to be improved.^{19,20}

Given that the factors that define the evolution include the left ventricle ejection fraction and the number of affected vessels, we identified that there was a higher percentage of high and moderate risk in group II. McPhee et al., in a study of 486 patients, recorded an improvement in cardiopulmonary

capacity after ECR before reaching 114 days,²¹ which demonstrates that offering early diagnosis, treatment and rehabilitation is crucial for a better functional prognosis.²²

The Infarction Code strategy and ECR showed important benefits. ECR initiation after emergency department admission averaged 1.86 days, with a decrease of 2.4 days with regard to regular cardiac

rehabilitation. We found a 2.4-day reduction in ICCU stay and 1.2 days in hospitalization, which suggested an early recovery and that harmful effects of immobility were avoided.²¹ This benefit was the result of strategies for patient enrollment and follow-up.²³ In 2017, Corcoran et al. conducted a study where they determined the effects of early rehabilitation at the ICCU; as in our study, they found a significant decrease in ICCU length-of-stay, from 4.6 to 3.7 days ($p = 0.05$), as well as a 40 % decrease in patients with prolonged stay of 6 to 3.4 days, an average that we observed in our research.²⁴

As for quality of life measured with the Velasco questionnaire, our results were positive, since patients in group II showed a quality of life improvement, reflected by a higher percentage of patients with mild deficit. Anchah et al. conducted a quality of life evaluation study in patients with acute coronary syndrome on cardiac rehabilitation early phase I, where they used the SF-36 questionnaire in a six to 12-month follow-up; they found an improvement in those treated early. Our results are the consequence of various timely medical care programs, education programs and supervised physical training.²⁵

In addition, in our analysis we show that the combined use of Infarction Code and ECR decreased disability by 9.1 days. If this figure is extrapolated to the expenditure on different resources per day of health care at the ICCU and hospitalization in secondary and tertiary care IMSS settings, possible savings per hospitalization day for the year 2016 might have been 6958 Mexican pesos.^{26,27} In 1993, Oldridge corroborated the cost-effectiveness benefits of cardiac rehabilitation programs; subsequently, Edwards et al., in a cost-effectiveness meta-analysis in cardiac rehabilitation, which encompassed the 2000 to 2014 period, indicated a similar average age and gender distribution. In our study, the lowest age at presentation was 22 years, which made the control of cardiovascular risk factors indispensable.²⁸ Corcoran et al. also noted that there are significant savings when early rehabilitation is carried out; they indicated a net saving of 1.5 million dollars.²⁴

In our study, we obtained positive results according to the reference to cardiac rehabilitation phase II; previously, the Cardiology Hospital had 15 % of references and, currently, it has 89 % with the seven axes of IMSS *A todo corazón* program implementation, which includes Infarction Code and ECR; however, increasing this rates of reference is still necessary in the different centers where ischemic heart disease is treated

in order to obtain substantial benefits from ECR. Among the various factors involved in the reference to cardiac rehabilitation, Goel et al. point at the role of the clinical cardiologist or attending physician; similarly, they point at the increase in references to cardiac rehabilitation over the past 10 years.²²

The limitations of our study included the reduced number of control patients and the respective follow-up of the population, which are aspects that should be improved in future research and in the corresponding evaluation of cardiovascular risk decrease.

Conclusions

We identified a favorable effect of ECR implementation in patients with acute myocardial infarction included in the Infarction Code program.

Resulting from a set of actions for improvement in timely diagnosis and treatment and early rehabilitation, better enrollment and adherence to the program in phase I was obtained, with a significant reduction in ICCU days of stay, hospitalization and disability and quality of life improvement. These results indicate better quality in the care of patients with acute myocardial infarction, and a replicable ECR model is therefore suggested in all units using the Infarction Code strategy.

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