

## Reperfusion in acute myocardial infarction in the elderly (clinical characteristics and prognosis). Results of the IMSS Nuevo León Infarction Code Program

*Reperusión en el infarto agudo de miocardio en ancianos (características clínicas y pronóstico). Resultados del Programa Código Infarto del IMSS Nuevo León*

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Coronary angioplasty, stent, elderly, acute myocardial infarction.

### Palabras clave:

Angioplastia coronaria, stent, ancianos, infarto agudo de miocardio.

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### ABSTRACT

**Introduction:** The age is an important prognostic factor in patients with acute myocardial infarction. As there are no data in the Mexican population, it is important to establish the characteristics and prognosis of older adults in whom mechanical reperfusion treatment is carried out. **Methods and results:** We carried out a retrospective analysis from January 1, 2016 to December 31, 2017 in which a total of 1,025 patients were included in the Infarction Code Program and received a myocardial reperfusion treatment, being the 15.3% over the age of 75 years of our patients. The age range was 33 to 92 years. The mortality rate increased exponentially with age (3.4% for patients  $\leq 54$  years, 6.1% for 55 to 64 years, 9.2% for 65 to 75 years and 15.9% for  $\geq 75$  years,  $p < 0.001$ ). In patients older than 75 years-old, primary angioplasty is the preferred method of reperfusion (77.7%), without an increase in cerebrovascular events. Over the age of 75 years-old, patients who develop cardiogenic shock have a higher mortality compared with younger ones (17.6, 28, 33 vs 56%,  $p < 0.001$ ). **Conclusions:** Despite the different treatments of reperfusion, mortality remains higher in older adults, mainly due to multiple comorbidities and a higher rate of ventricular dysfunction.

### RESUMEN

**Introducción:** La edad es un factor pronóstico en los pacientes con infarto agudo de miocardio. Al no encontrar datos similares en la población mexicana, se busca establecer las características y pronóstico de los adultos mayores llevados a tratamiento de reperusión mecánica. **Métodos y resultados:** Se llevó a cabo un análisis retrospectivo de enero de 2016 al 31 de diciembre 2017 en el que se incluyeron un total de 1,025 pacientes en el programa Código Infarto llevados a tratamiento de reperusión, siendo el 15.3% mayores de 75 años. El rango de edad fue de los 33 a los 92 años. La mortalidad aumentó de forma exponencial a mayor edad (3.4% para los pacientes  $\leq 54$  años, 6.1% para 55 a 64 años, 9.2% para 65 a 75 años y 15.9% para los  $\geq 75$  años,  $p < 0.001$ ). En los pacientes mayores de 75 años, la angioplastia primaria es el método de reperusión preferido (77.7%), sin encontrar en este grupo de pacientes un aumento en el número de eventos vasculares cerebrales. Los pacientes mayores de 75 años que desarrollan choque cardiogénico tienen una mortalidad mucho mayor comparada con los más jóvenes (17.6, 28, 33 vs 56%,  $p < 0.001$ ). **Conclusiones:** A pesar de los diferentes tratamientos de reperusión, la mortalidad sigue siendo más elevada en los adultos de edad avanzada, principalmente por múltiples comorbilidades y una tasa más alta de disfunción ventricular.

## INTRODUCTION

Cardiovascular disease is the main cause of morbidity and mortality among older adults, so this is the reason why this group is currently considered of vital importance in the study of ischemic heart disease.<sup>1</sup> We know that age is a major cardiovascular risk factor and coronary artery disease (CAD) is the main cause of death in old age.<sup>2</sup> In the United States, there is an annual increase of 160,000 octogenarians estimating that by 2040, there will be an increase of 5 times the current population of that group of people.<sup>3</sup> Although there is no established age cut-off for this group, people aged 75 and older are usually referred to as «older adults», based on the fact that the treatment guidelines emphasize this group of patients, issuing some changes from this age.<sup>3</sup> Although it is true that these international treatment recommendations make no difference in diagnosis and treatment according to age, in real life, older adults historically have lower rates of revascularization compared with younger patients,<sup>4</sup> as well as in the main controlled clinical trials this group of patients is underestimated or even excluded. However, in recent years there has been an attempt to offer percutaneous coronary intervention (PCI) to this group of patients, so that, in practice, one in five patients treated by PCI, belongs to this group.<sup>5</sup> In our country, we do not have studies that evaluate the outcome of this population in the context of an acute myocardial infarction with ST-segment elevation, so in this study it is intended to analyze the characteristics of this age group and the similarities or differences with the younger population and the results obtained with the reperfusion treatment.

## METHODS

### Cohort and study protocol

The «Infarction Code» program of the Mexican Institute of Social Security, consists of providing mechanical reperfusion treatment to patients with acute myocardial infarction with ST-segment elevation (STEMI), who come to the Emergency Department of our Hospital or are treated in hospitals without a primary angioplasty facility. This study is a retrospective analysis of a

single third level hospital center, which includes all patients with STEMI taken to mechanical reperfusion treatment in any of its modalities (primary, early or rescue angioplasty). The data were obtained in detail from the file and electronic database belonging to the Department of Hemodynamics and Interventionism. Acute myocardial infarction with ST segment elevation (STEMI) was defined as an episode of angina of more than 20 minutes duration in conjunction with any of the following: (1) ST segment elevation of more than 0.2 mV in two contiguous leads (V1 to V3) and more than 0.1 mV in any other derivation, or (2) the presence of left bundle branch block (LBBB). The success of the procedure was defined as a post-procedure TIMI 2 or 3 flow. The left ventricle ejection fraction was obtained from the transthoracic echocardiogram performed upon admission to the Coronary Care Unit. The outcomes that were compared between the four groups included non-fatal reinfarction, acute and subacute stent thrombosis, ischemic cerebral vascular event, major hemorrhage and intrahospital mortality at 30 days. In summary, 1,025 patients of any age with AMI within the first 12 hours at the onset of symptoms, between January 2016 and December 2017. All patients received aspirin and clopidogrel prior to the procedure. The frequency of events was assessed in both the in-hospital and extra-hospital phases through follow-up by external consultation.

### Statistic analysis

The demographic, angiographic and procedural variables, and clinical results based on age were determined by the analysis of four groups ( $\leq 54$  years, 55-64, 65-74 and  $\geq 75$  years). Fisher's exact test was used for the comparison of the categorical variables and the test of  $\chi^2$  for the comparison between the four groups. Logistic and multivariate regression analyzes were performed to identify independent predictors.

## RESULTS

### Baseline characteristics

The average age of the 1,025 patients was 62 years, in a range of 33 to 92 years. Patients  $\leq$

54, 55-64, 65-74 and  $\geq 75$  years (group 1, 2, 3 and 4 respectively) form 22.9%, 33.2%, 28.5% and 15.4% of the study cohort. As seen in *Table 1*, older adults have a higher proportion of women, and a higher prevalence of hypertension, and previous cerebral vascular event. Cardiovascular risk factors such as diabetes mellitus, dyslipidemia or tobacco use were not more frequent in the group of older adults, and were more prevalent at younger ages. In our cohort, the history of infarction and revascularization treatment was found in a lower proportion in the older group.

#### Characteristics of the procedure

As shown in *Table 2*, the older adults compared with the younger ones, presented a tendency to greater coronary multivascular involvement as well as more diffuse disease, and arteries of smaller diameter. Basal and postprocedural TIMI flow was independent of age. The type of procedure also varied in different age groups,

with a preference for primary angioplasty in those of older age. The radial approach was used less frequently in the elderly, as well as the administration of glycoprotein IIb/IIIa inhibitors (abciximab or tirofiban).

#### Mortality and events greater than 30 days

As shown in *Table 3*, compared with younger patients, older adults had the highest mortality. In the multivariate analysis, advanced age is a strong independent predictor of death (hazard ratio 1.08, 95% CI 1.03 to 1.1,  $p < 0.001$ ) and major bleeding (hazard ratio 1.05, 95% CI 1.03 to 1.09  $p < 0.02$ ). In contrast, the rate of ischemic stroke, intracerebral hemorrhage, and stent thrombosis were not directly related to age.

#### DISCUSSION

The main findings of this registry represent the largest cohort of the Mexican population

Table 1: Baseline characteristics according to age.

	Group 1 $\leq 54$ years	Group 2 55-64 years	Group 3 65-74 years	Group 4 $\geq 75$ years	p
Patients (n)	235	341	292	157	
Age (years)	48.4 (33-54)	59.4	68.9	79.4 (75-92)	
Women	29 (12.3)	59 (17.3)	89 (30.4)	58 (36.9)	$< 0.00001$
Hypertension	110 (46.8)	189 (55.4)	185 (63.3)	129 (82.1)	$< 0.00001$
Diabetes mellitus	102 (43.4)	168 (49.2)	154 (52.7)	75 (47.7)	0.19
Tobacco	138 (58.7)	187 (54.8)	58 (19.8)	59 (37.5)	$< 0.00001$
Dyslipidemia	72 (30.6)	94 (27.5)	88 (15.7)	46 (29.2)	0.85
Previous myocardial infarction	29 (12.3)	57 (16.7)	48 (16.4)	12 (7.6)	0.02
Previous CABG	0 (0)	2 (0.5)	3 (1.0)	1 (0.6)	0.85
Previous PCI	6 (2.5)	11 (3.2)	6 (2.0)	3 (1.9)	0.75
Onset symptoms before first medical contact (minutes)	182	168	200	207	0.003
Killip-Kimball at the arrival					
Class 1	199 (84.7)	296 (86.8)	238 (81.5)	120 (76.4)	0.02
Class 2-3	19 (8.1)	24 (7.0)	37 (12.6)	22 (14.0)	0.02
Class 4	17 (7.2)	21 (6.2)	18 (6.1)	15 (9.6)	0.51
Left ventricular ejection fraction (%)	58	57	50	44	0.02

Table 2: Baseline angiographic and procedural characteristics according to age.

	Group 1 ≤ 54 years	Group 2 55-64 years	Group 3 65-74 years	Group 4 ≥ 75 years	p
Target vessel lesion					
Left anterior descending	136 (57.8)	166 (48.6)	140 (48.0)	78 (49.6)	0.55
Right coronary	74 (31.5)	139 (40.9)	125 (42.8)	59 (37.8)	0.29
Circumflex/OM	22 (9.3)	31 (9.0)	20 (6.8)	15 (9.5)	0.71
Left main	1 (0.84)	2 (0.58)	2 (0.34)	2 (1.2)	0.78
Other	2 (0.42)	3 (0.87)	5 (1.7)	3 (1.9)	0.64
Trivascular coronary disease	42 (17.8)	80 (23.4)	67 (22.9)	45 (28.6)	0.09
Basal TIMI flow					
0-1	146 (62.1)	222 (65.1)	187 (64.0)	96 (61.1)	0.78
2	29 (12.3)	35 (10.2)	27 (9.2)	14 (8.9)	0.62
3	60 (25.6)	84 (24.7)	78 (26.8)	47 (30.0)	0.64
Postprocedure TIMI flow					
0-1	18 (7.6)	30 (8.9)	20 (6.9)	14 (8.9)	0.79
2	20 (8.5)	43 (12.6)	32 (11.0)	20 (12.7)	0.42
3	197 (83.8)	268 (78.5)	240 (82.1)	123 (78.4)	0.32
Type of percutaneous intervention					
Primary angioplasty	150 (63.8)	232 (68.0)	210 (71.9)	122 (77.7)	0.02
Early angioplasty	46 (19.5)	65 (19.0)	49 (16.7)	21 (13.3)	0.36
Rescue angioplasty	33 (14.0)	35 (10.2)	30 (10.2)	11 (7.0)	0.16
Radial access	175 (74.4)	232 (68.0)	187 (64.0)	92 (58.6)	0.006
Femoral access	60 (25.6)	100 (32.0)	105 (36.0)	65 (41.4)	0.006
Crossover (radial to femoral)	7 (2.9)	6 (1.7)	8 (2.7)	7 (4.4)	0.38
Stents implantations	200 (85.1)	298 (87.3)	260 (89.0)	126 (80.2)	0.06
Use of GPI IIB/IIIa	123 (52.3)	159 (46.6)	130 (44.5)	50 (31.8)	0.0009
Use of BIAC	20 (8.5)	23 (6.7)	25 (8.5)	18 (11.4)	0.45
Use of temporal pacemaker	22 (9.3)	38 (11.1)	53 (18.1)	29 (18.4)	0.003

IBAC = Intraaortic Balloon Counterpulse.

with these characteristics. There is no registry in our population that examines the results of mechanical reperfusion therapy in the elderly patients during hospitalization and follow-up. First, older adults with acute myocardial infarction who are taken to PCI present with a greater number of comorbidities, which confer a worse prognosis in the short and long term. It is striking that, in the population studied, the history of coronary artery disease and revascularization by any method is not more prevalent in older adults, which is not

in relation to that published in international series, rather, it reflects the lack of medical attention in this group of patients, and with it the importance of programs for the care of acute myocardial infarction. One of the main factors in the success of reperfusion treatment is to establish the time from the onset of symptoms to the reperfusion treatment, and between the onset of symptoms and the first medical contact, finding a relationship that, at older age, the diagnosis and treatment is delayed. It also correlates with clinical class

Table 3: 30-day results.

	Group 1 ≤ 54 years	Group 2 55-64 years	Group 3 65-74 years	Group 4 ≥ 75 years	p
Death	8 (3.4)	21 (6.1)	27 (9.2)	25 (15.9)	0.0003
Acute/subacute Stent thrombosis	0 (0)	2 (0.58)	3 (1.02)	0 (0)	0.85
Stroke	3 (1.2)	2 (0.58)	3 (1.02)	0 (0)	0.81
Access site bleeding	0 (0)	2 (0.58)	1 (0.34)	2 (1.2)	0.64
Intracranial hemorrhage	1 (0.42)	1 (0.29)	1 (0.34)	0 (0)	0.95

Table 4: Mortality associated with cardiogenic shock.

	Group 1 ≤ 54 years	Group 2 55-64 years	Group 3 65-74 years	Group 4 ≥ 75 years	p
Mortality in patients without cardiogenic shock	5 (2.1)	14 (4.1)	19 (6.6)	11 (7.6)	0.54
Patients with cardiogenic shock (on admission or during hospitalization)	17 (7.2)	25 (7.3)	24 (8.2)	22 (14.0)	0.12
Mortality in cardiogenic shock	3 (17.6)	7 (28.0)	8 (33.3)	14 (56.0)	< 0.001

on admission, assessed by the Killip-Kimball scale, with a greater number of patients with grade II and III class. Although the presence of cardiogenic shock on admission was not more prevalent in the elderly, its presence does influence the prognosis. Compared with younger patients, in older adults coronary artery disease is more extensive, which has a direct relationship with more depressed ventricular function and the development of cardiogenic shock. Although in different series, the rate of ischemic or hemorrhagic cerebral vascular event is observed more frequently in the elderly,<sup>6</sup> in our series this phenomenon was not observed, which may be the explanation, that primary angioplasty is preferred, minimizing the risk of thrombolysis (the intracranial hemorrhage events of the cohort occurred in thrombolized patients)<sup>7</sup> as well as a decrease in the use of glycoprotein IIb/IIIa inhibitors, which have not shown a strong benefit in the elderly. While the radial approach was used less frequently in older

adults, the rate of bleeding related to access was not more frequent in this group and the need for conversion to the femoral approach is not greater compared with younger patients.<sup>5,8</sup> It is important to emphasize that the success of the procedure is not affected by age, although we know that coronary anatomy is much more complex, mechanical reperfusion can be carried out in older adults with success rates similar to younger ones.<sup>9</sup> With this, we realize that the factors of greater weight in the mortality of this group are the comorbidities related to age, and mainly the development of left ventricular dysfunction.<sup>10</sup> When we compare mortality in patients who do not develop cardiogenic shock, it is similar for any age group (2.1, 4.1, 6.6 and 7.6% p = 0.54 for groups 1, 2, 3 and 4 respectively). However, in the subgroup patients with cardiogenic shock, age is an independent factor for death, which implies that, in advanced age the possibility of reversing this state of shock is much lower (17.6, 28.0, 33.3 and 56.0% p = 0.001 for

groups 1, 2, 3 and 4 respectively), this is largely conditioned by the extension of coronary artery disease, previous ventricular dysfunction and multiple associated comorbidities (Table 4).

#### Study limitations

This study has the limitations of the registries, where the comparison between the groups is not randomized. In addition, it is a record of a single hospital center, so these results are the accumulation of experience and management of this center, and can not be extrapolated to all hospitals in the country.

#### CONCLUSIONS

The elderly of the Infarction Code Program in our entity represent 15.3% of the procedures performed, with a tendency to increase their frequency in the short term. The clinical characteristics of older adults include higher comorbidity, more complex coronary anatomy, and acute myocardial infarction with more critical clinical presentation. Primary angioplasty is the method of choice in this group of patients, which significantly reduces the risk of major bleeding. Although postprocedural results are comparable among all age groups, mortality increases with age, results that are comparable to the series published in the literature.

#### REFERENCES

1. Shanmugam VB, Harper R et al. An overview of PCI in the very elderly. *J Geriatr Cardiol*. 2015; 12: 174-184.
2. Wang TY, Gutiérrez A, Peterson DE. Percutaneous coronary intervention in the elderly. *Nat Rev Cardiol*. 2011; 8: 79-90.
3. Ibanez B, James S, Agewall S, Antunes MJ, Bucciarelli-Ducci C, Bueno H et al. 2017 ESC Guidelines for the management of acute myocardial infarction in patients presenting with ST-segment elevation: The Task Force for the management of acute myocardial infarction in patients presenting with ST-segment elevation of the European Society of Cardiology (ESC). *Eur Heart J*. 2018; 39 (2): 119-177.
4. Levine GN, Bates ER et al. 2011 ACCF/AHA/SCAI Guideline for Percutaneous Coronary Intervention. *J Am Coll Cardiol*. 2011; 58: e44-122.
5. Campo C, Ferreira RP, Teixeira C et al. Percutaneous coronary intervention using transradial access in elderly vs. non-elderly patients. *Rev Bras Cardiol Invasiva*. 2013; 21 (1): 36-42.
6. Thiemann DR, Coresh F, Shulman P et al. Lack of benefit for intravenous thrombolysis in patients with myocardial infarction who are older than 75 years. *Circulation*. 2000; 101: 2239-2246.
7. Capodanno D, Angiolillo DJ. Antithrombotic therapy in the elderly. *J Am Coll Cardiol*. 2010; 56: 1683-1692.
8. Hsieh V, Jolly SS. Should radial access be the preferred approach in the elderly? *Rev Bras Cardiol Invasiva*. 2012; 20 (1).
9. Sim WL, Mutha V et al. Clinical characteristics and outcomes of octogenarians presenting with ST elevation myocardial infarction in the Australian population. *World J Cardiol*. 2017; 9 (5): 437-441.
10. Guagliumi G, Stone GW, Cox DA et al. Outcome in elderly patients undergoing primary coronary intervention for acute myocardial infarction, results from the controlled abciximab and device investigation to lower late angioplasty complications (CADILLAC) trial. *Circulation*. 2004; 110: 1598-1604.

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