

Immediate complications after thrombolysis for acute myocardial infarction: a prospective study

Complicaciones inmediatas posttrombólisis por infarto agudo al miocardio: estudio prospectivo

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Abstract

Background: Acute myocardial infarction (AMI) is the leading cause of death worldwide; fibrinolytic therapy is a fundamental part of its treatment, which is why identifying its possible immediate complications has become extremely important. **Objective:** Determine the immediate complications following fibrinolytic treatment for acute myocardial infarction. **Material and methods:** Descriptive, longitudinal, prospective study in a second-level IMSS hospital in Puebla. Sixty patients over 18 years of age with ST-segment elevation acute myocardial infarction who received fibrinolytic therapy were included. Data analysis was performed using descriptive statistics, and a correlation was performed using Spearman's Rho. **Results:** 65% of the population was male, with a mean age of 66 years; the predominant associated comorbidity was systemic arterial hypertension. The most frequent complication was arrhythmias in 58.8%, and the correlation between sex and the presence of complications obtained a $p = 0.017$. **Conclusions:** ST-segment elevation acute myocardial infarction is more common in men between the ages of 50 and 60. Complications associated with fibrinolytic therapy are frequent, so identifying this condition is essential when treating this pathology.

Keywords: Acute coronary syndrome. ST elevation myocardial infarction. Fibrinolysis.

Resumen

Antecedentes: El infarto agudo al miocardio (IAM) es la principal causa de mortalidad en todo el mundo. La terapia fibrinolítica constituye una parte fundamental para su tratamiento, por lo que la identificación de sus posibles complicaciones inmediatas ha tomado gran relevancia. **Objetivo:** Determinar las complicaciones inmediatas posterior al tratamiento fibrinolítico por IAM. **Material y métodos:** Estudio descriptivo, longitudinal y prospectivo en un hospital de segundo nivel del Instituto Mexicano del Seguro Social en Puebla. Se incluyeron 60 pacientes mayores de 18 años con IAM con elevación del segmento ST y que recibieron terapia fibrinolítica. El análisis de los datos se hizo con estadística descriptiva y se realizó una correlación con rho de Spearman. **Resultados:** El 65% de la población fue de sexo masculino, con una edad media de 66 años. La comorbilidad asociada predominante fue hipertensión arterial sistémica. La complicación más frecuente fueron las arritmias en el 58.8%, y la correlación entre el sexo y la presencia de complicaciones obtuvo $p = 0.017$. **Conclusiones:** El IAM con elevación del segmento ST es más frecuente en los hombres entre la quinta y la sexta décadas de la vida, y las complicaciones asociadas a la terapia fibrinolítica son frecuentes, por lo que su identificación es fundamental durante el abordaje de esta patología.

Palabras clave: Síndrome coronario agudo. Infarto del miocardio con elevación del ST. Fibrinólisis.

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Introduction

Cardiovascular diseases have increased their relevance in recent decades and have become one of the main causes of mortality worldwide, also generating a significant economic impact on public and private health systems. Within this group, acute myocardial infarction (AMI) represents the most frequent entity and of greatest clinical relevance^{1,2}.

AMI is defined as evidence of myocardial necrosis in a clinical context compatible with acute myocardial ischemia, identified by an increase in cardiac biomarkers, particularly troponins, above the 99th percentile, associated with characteristic electrocardiographic findings such as ST-segment elevation or depression, left bundle branch block, and the appearance of pathological Q waves; findings in imaging studies with myocardial loss or wall motion abnormality and identification of coronary thrombus through angiography and/or autopsy are also very useful³.

Globally, AMI has a higher prevalence in people over 60 years of age, with an approximate incidence of 9.5%, with males being the most affected with a mean age of presentation of 65 years^{4,5}. In Mexico, this pathology constitutes the first cause of mortality in men over 45 years of age, with a mean age of presentation of 63.3 years^{6,7}.

From a pathophysiological point of view, AMI originates mainly from the rupture of an atheromatous plaque in the coronary arteries, which triggers a local inflammatory response mediated by macrophages and monocytes, favoring platelet activation and thrombus formation. This process leads to partial or total obstruction of coronary blood flow, generating myocardial ischemia and, if the occlusion persists, irreversible necrosis of the affected tissue^{8,9}. The sudden interruption of blood flow causes structural and functional injury to myocardial cells, culminating in ischemic necrosis due to lack of oxygen and essential nutrients^{10,11}. Less common mechanisms include coronary vasospasm, congenital or acquired anatomical abnormalities, spontaneous coronary dissection, and coronary embolisms^{12,13}.

Risk factors associated with AMI are classified as modifiable and non-modifiable. In young patients (< 45 years), the main non-modifiable factors include male sex, systemic arterial hypertension, type 2 diabetes mellitus, and hereditary family history of myocardial infarction. Among modifiable factors, smoking, obesity, dyslipidemia, and drug use stand out^{14,15}. In elderly patients, the predominant sex continues to be male;

however, the female sex is related to greater hemodynamic involvement and the appearance of complications, and after menopause the incidence equals that of the male sex^{16,17}.

The diagnosis is made through typical clinical manifestations (precordial pain, of retrosternal location, with increased intensity, oppressive, burning, which may radiate and does not subside with rest) or atypical (in special groups such as diabetic patients or elderly adults)^{18,19}, electrocardiogram (elevation or non-elevation of the ST segment in 2 contiguous leads and amplitude according to sex, new appearance of left or right bundle branch block), and elevated troponins (above the 99th percentile)^{20,21}.

The treatment of choice for this pathology is early reperfusion, which is a fundamental strategy to reduce associated morbidity and mortality. This can be performed through percutaneous coronary intervention (PCI) or fibrinolytic therapy (alteplase or tenecteplase)^{22,23}.

Regarding fibrinolytic therapy, post-thrombolysis complications have been documented immediately (< 6 hours) or in a delayed manner (6-24 hours); among the most frequent are hemorrhage, cardiogenic shock, acute pulmonary edema, atrial fibrillation, angina, hypotension, nausea, vomiting, and allergic reactions^{24,25}.

The objective of the present study was to determine the immediate complications following fibrinolytic treatment for AMI.

Material and methods

An observational, descriptive, impact, longitudinal, unicentric, homodemic, and prospective study was conducted in a second-level hospital of the Mexican Social Security Institute in Puebla, Mexico, during the period from January to June 2024. Patients over 18 years of age with a diagnosis of ST-segment elevation acute myocardial infarction, established through clinical, laboratory (troponin determination), and electrocardiographic criteria, who came to the emergency department within a therapeutic window of less than 12 hours from symptom onset and who were treated with tenecteplase, were included. Those with non-ST-segment elevation AMI and those with absolute and relative contraindications for thrombolysis were excluded. Patients who requested to leave the study for any reason were eliminated.

The variables analyzed included sociodemographic data (age, sex, and occupation), cardiovascular and metabolic comorbidities, clinical characteristics, and the presence of immediate complications following

fibrinolytic therapy, defined as those that occurred within the first 6 hours after tenecteplase administration; these include the presence of arrhythmias, hypotension, reperfusion failure, cardiogenic shock, acute pulmonary edema, or hemorrhagic events.

Statistical analysis was performed using the Statistical Package for the Social Sciences software (SPSS v25.0). Descriptive statistics were used to analyze the frequencies and percentages of the evaluated population, using measures of central tendency and dispersion. The normality of quantitative variables was evaluated using the Kolmogorov-Smirnov test. The correlation between sex and the presentation of complications was analyzed using Spearman's Rho test, considering $p < 0.05$ as statistically significant.

Results

A total of 60 patients who met the inclusion criteria were recruited; there was a predominance of males, with 39 (65.0%) patients, while 21 (35.0%) were female; the mean age was 66 years (SD + 13), with a minimum of 35 and a maximum of 88 years.

Regarding occupation, the most frequent was retired in 29 (48.3%) patients, while the least frequent was housewife in 2 (3.3%). The remaining results are shown in [table 1](#).

Regarding comorbidities, systemic arterial hypertension was the most frequent, occurring in 57 (95%) patients, followed by type 2 diabetes in 39 (65%), obesity in 30 (50%), and sedentary lifestyle in 26 (43.3%); the least frequent comorbidities were chronic kidney disease in 5 (8.3%) patients and previous ischemic heart disease together with family history of acute myocardial infarction in 12 (20%) patients each. Details are shown in [table 2](#).

Regarding the clinical manifestations associated with acute myocardial infarction in our population, the predominant symptom was retrosternal pain, reported in 55 (91.7%) patients, while 5 (8.3%) presented epigastric pain. Pain radiation to the jaw was observed in 31 (51.7%) patients; 39 (65%) patients presented pain in the left arm, 36 (60%) had dyspnea, 47 (78.3%) had diaphoresis, and 19 (31.7%) reported vertigo ([Table 3](#)).

All patients were treated with tenecteplase, and a total of 17 (28.3%) patients presented immediate complications, of which the most frequent were arrhythmias in 10 (58.8%) patients, followed by hypotension (23.5%) and reperfusion failure (17.6%); it is important to mention that none of the patients presented hemorrhage as

Table 1. Occupation

Activity	(n = 60)	%
Retired	29	48.3
Employed	25	41.7
Housewife	2	3.3
Unemployed	4	6.7

Table 2. Comorbidities

Disease or condition	Yes		No	
	(n = 60)	%	(n = 60)	%
Smoking	15	25.0	45	75.0
Sedentary lifestyle	26	43.3	34	56.7
Obesity	30	50.0	30	50.0
Systemic arterial hypertension	57	95.0	3	5.0
Type 2 diabetes	39	65.0	21	35.0
Previous ischemic heart disease	12	20.0	48	80.0
Dyslipidemia	18	30.0	42	70.0
Chronic kidney disease	5	8.3	55	91.7
Family history of AMI	12	20.0	48	80.0

AMI: acute myocardial infarction.

Table 3. Clinical characteristics

Variables	Yes		No	
	(n = 60)	%	(n = 60)	%
Thoracic pain	55	91.7	5	8.3
Epigastric pain	5	8.3	55	91.7
Pain radiating to jaw	31	51.7	29	48.3
Left arm pain	39	65.0	21	35.0
Dyspnea	36	60.0	24	40.0
Diaphoresis	47	78.3	13	21.7
Vertigo	19	31.7	41	68.3

a complication. The distribution of complications is shown in [table 4](#).

When analyzing the relationship between sex and the presence of immediate complications, it was observed

that 38.5% of male patients presented some type of complication, compared to 9.5% of the female sex. Analysis using Spearman's Rho correlation test showed a coefficient of 0.336, with a $p = 0.017$. The remaining results are shown in [table 5](#).

Discussion

In this study, 60 patients with ST-segment elevation AMI who were treated with thrombolytic therapy were included; a clear predominance of the male sex was observed at 65%, which is consistent with that reported by Martínez et al. and Pérez et al.,^{26,27} who obtained a predominance of the male sex at 75% and 73.2%, respectively. This marked predominance in the male sex is explained by a combination of biological mechanisms (lower estrogen levels), the presence of risk factors (they tend to exhibit it in a higher proportion compared to women) and behavioral factors^{28,29}.

The mean age of presentation reported in national and international literature varies from approximately 62-64 years^{26,27}, similar to what was found in our study, with a mean age of 66 years.

AMI is associated with cardiovascular risk factors such as dyslipidemia, systemic arterial hypertension, metabolic syndrome, diabetes mellitus, smoking, sedentary lifestyle, and obesity². In this study, it was found that the predominant comorbidity was systemic arterial hypertension at 95%, followed by type 2 diabetes at 65% and obesity at 50%, which is consistent with that reported by Sánchez et al., in which arterial hypertension predominated at 30%, followed by a history of cardiovascular disease at 24% and diabetes mellitus at 23%³⁰. However, Mora et al.³¹ reported that the most frequent cardiovascular factor was smoking at 68.4%, followed by sedentary lifestyle at 59.6% and, in third place, systemic arterial hypertension at 56.1%.

Regarding clinical presentation, Castro et al.,¹⁹ in their study conducted in Cuba, found that the majority of their study population presented retrosternal pain in 81.3%, with a sensation of oppression in 76% and with radiation to the left shoulder and arm in 92%; which is consistent with what was obtained in this work with a predominance of retrosternal pain in 91.7%, with radiation to the jaw in 65% and to the left arm in 60%.

Of our study population, 28.3% presented complications following fibrinolytic treatment with tenecteplase, the most frequent being arrhythmias at 58.8%, followed by hypotension at 23.5% and reperfusion failure at 17.6%; it is worth mentioning that none of our

Table 4. Complications

Distribution of complications	n	%
Presentation of complications (n = 60)		
Yes	17	28.3
No	43	71.7
Type of complications (n = 17)		
Hemorrhage	0	0.0
Arrhythmias	10	58.8
Hypotension	4	23.5
Reperfusion failure	3	17.6
Allergy	0	0.0
Mechanical	0	0.0

Table 5. Complications in relation to sex

Complications	Male (n = 39)		Female (n = 21)		Spearman's Rho (p)
	n	%	n	%	
Yes	15	38.5	2	9.5	0.017
No	24	61.5	19	90.5	

patients presented hemorrhage. The absence of hemorrhagic events in our population is relevant, since in contrast to what is reported in other studies such as that of Rego et al., in which 18% presented complications, the most frequent being hypotension at 19.34%, followed by nausea at 5.27%³²; and that of Mora et al.,³¹ who reported in their population 10.5% with complications associated with fibrinolysis, and of these, hemorrhage predominated in 100% of patients. This finding can be explained by adequate patient selection, adherence to established contraindications, and the use of tenecteplase, which has demonstrated a favorable safety profile compared to other fibrinolytic agents.

Regarding the relationship between sex and the presence of complications, 38.5% of the male patients in our study presented complications compared to only 9.5% of female patients, with a $p = 0.017$, which is statistically significant. This result has been reported variably in the literature; some studies suggest a higher incidence of complications in men, while others describe greater severity and worse prognosis in women. These differences could be related to hormonal factors, different risk profiles, or variations in response to treatment, which underscores the need for additional research to clarify the impact of sex on early evolution following fibrinolysis.

The main limitations of the study include its observational design, the relatively small sample size, and the follow-up period restricted to the first hours following fibrinolytic treatment. This study is among the few conducted in our country on this subject and contributes significantly to information on thrombolytic treatment and its associated complications. However, it is a starting point for future research with the areas of opportunity already mentioned for better comparison of results.

Conclusion

In this study, it was observed that ST-segment elevation acute myocardial infarction was more frequent in males, with an average age in the sixth decade of life. The predominant comorbidities were systemic arterial hypertension, type 2 diabetes mellitus, and obesity.

Approximately one-third of patients presented immediate complications following fibrinolytic therapy with tenecteplase, with arrhythmias being the most frequent complication, followed by hypotension and reperfusion failure. No hemorrhagic events were documented during the observation period.

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Conflicts of interest

The authors declare no conflicts of interest.

Ethical considerations

Protection of human subjects and animals. The authors declare that no experiments on humans or animals were performed for this research.

Confidentiality, informed consent, and ethical approval. The authors have followed their institution's confidentiality protocols. This study was approved by the Local Health Research Committee No. 2108 of the *Instituto Mexicano del Seguro Social*, with registration number R-2024-2108-003. Informed consent was obtained from the patients, and approval from the Ethics Committee is available. Information was handled with strict confidentiality criteria between the physician and the participant and was used exclusively for research purposes. SAGER guidelines

have been followed as applicable to the nature of the study.

Declaration on the use of artificial intelligence.

The authors declare that no generative artificial intelligence was used in the writing or creation of the content of this manuscript.

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