

# Cardiac Arrest as Presenting Symptom in ST-Segment Elevation Acute Coronary Syndrome. Data From The ARGEN-IAM-ST Registry

*Paro cardiorrespiratorio como forma de presentación del síndrome coronario agudo con elevación del segmento ST. Datos del registro ARGEN-IAM-ST*

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## ABSTRACT

**Background:** Cardiac arrest (CA) in the context of acute coronary syndrome is a major cause of out-of-hospital and in-hospital death. Some patients present CA as the initial manifestation of the condition, and although almost half of them do not reach healthcare centers and die, others may be hospitalized.

**Objectives:** The aim of this study was to describe the prevalence of CA as a presenting symptom in ST-segment elevation myocardial infarction, and analyze the characteristics of these patients, treatment, and in-hospital mortality.

**Methods:** We conducted a retrospective analysis of patients included in the ARGEN-IAM-ST registry. Data regarding patients' characteristics, reperfusion strategies, and in-hospital outcomes were collected. The Redcap case record form has an item called "presenting symptoms" where physicians check the Killip and Kimball (KK) class on admission and the presence (yes box) or absence (no box) of CA. Cardiac arrest was defined as the sudden cessation of cardiac activity that can lead to death if resuscitation measures are not taken or if they are unsuccessful.

**Results:** A total of 7505 patients were included between March 2014 and April 2025. Cardiac arrest was the presenting symptom in 7.5% of cases (n = 564). Patients presenting with CA were older (median age 62 vs. 61 years) and had a higher prevalence of diabetes (32.8% vs. 26.8%), hypertension (61% vs. 53.5%), history of coronary artery disease (16.5% vs. 14.9%), chronic obstructive pulmonary disease (4.8% vs. 2.9%), and peripheral vascular disease (2.1% vs. 1.1%), with statistically significant differences in all cases. On coronary angiography, left main coronary artery disease (6.7% vs. 0.9%, p < 0.001), left anterior descending coronary artery disease (48.6% vs. 47.6%, p < 0.001), and multivessel disease (32.3% vs. 29.5%, p = 0.004) were mostly common. Patients with CA as presenting symptom were less likely to receive reperfusion therapy (85.2% vs. 90.9%, p < 0.001) and primary percutaneous coronary intervention (PCI) 67.9% vs. 75.2%, p = 0.014). There were no differences in door-to-balloon time among those undergoing PCI. In patients with CA as the presenting symptom, 48.6% were in KK class D on admission. The use of mechanical ventilation (MV) was 50.4% vs. 5.1% (p < 0.001). In patients with CA on admission, in-hospital mortality was 50.5% versus 4.6% (p < 0.001). Mortality in patients with KK class D and CA on admission was 71%, and 36% in KK class D patients without CA (p < 0.001). In multivariate analysis, diabetes and KK D were independent predictors of CA.

**Conclusion:** One out of 7 STEMI patients arrives at a healthcare center with CA as the presenting symptom. These patients exhibit an elevated risk profile, are less likely to receive reperfusion treatment and exhibit an increased incidence of heart failure, shock, and requirements of MV. Half of the patients presenting with CA die during hospitalization. This figure rises to 7 out of 10 if the patient also has cardiogenic shock on admission. Training staff in cardiopulmonary resuscitation (CPR) and post-cardiac arrest management is essential to reducing mortality.

**Keywords:** Myocardial infarction - Cardiac arrest - Registry

## RESUMEN

**Introducción:** El paro cardiorrespiratorio (PCR) en el contexto de un síndrome coronario agudo es una causa importante de muerte, tanto extra como intrahospitalaria. Algunos pacientes presentan PCR como manifestación inicial del cuadro, y si bien casi la mitad de ellos no llegan a los centros asistenciales y fallecen, otros pueden ser ingresados.

**Objetivos:** 1) Describir la prevalencia de PCR como forma de presentación en el infarto agudo de miocardio con elevación del segmento ST. 2) Analizar las características de dichos pacientes, el tratamiento y la mortalidad intrahospitalaria.

**Material y métodos:** Se trata de un análisis retrospectivo de los pacientes incluidos en el registro ARGEN-IAM-ST. Se recabaron datos acerca de las características de los pacientes, estrategias de reperusión y evolución intrahospitalaria. La ficha de registro en

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Redcap cuenta con un ítem llamado “forma de presentación” y allí los médicos consignan tanto el Killip y Kimball (K-K) de ingreso como si hubo PCR (casillas de sí/no). Se definió PCR al brusco cese de la actividad cardíaca que puede conducir a la muerte si no se toman medidas de reanimación o si estas no son exitosas.

**Resultados:** Se incluyeron 7505 pacientes entre marzo de 2014 y abril de 2025. Un 7,5 % tuvo PCR como forma de presentación (n=564). Los pacientes que se presentaron con PCR fueron más añosos (mediana de 62 vs. 61 años) y con mayor prevalencia de diabetes (32,8 % vs. 26,8 %), hipertensión arterial (61 % vs. 53,5 %), antecedentes coronarios (16,5 % vs. 14,9 %), enfermedad pulmonar obstructiva crónica, (4,8 % vs. 2,9 %), y enfermedad vascular periférica (2,1 vs. 1,1 %), en todos los casos con diferencia estadísticamente significativa. En la cinecoronariografía presentaron más frecuentemente lesión de tronco de coronaria izquierda (6,7 % vs 0,9 %, p < 0,001) descendente anterior (48,6 % vs. 47,6 %, p < 0,001) y múltiples vasos (32,3 % vs 29,5%, p=0,004). Asimismo, fueron menos reperfundidos (85,2 % vs. 90,9 %, p<0,001) y recibieron menos angioplastia transluminal coronaria (ATC) primaria (67,9 % vs. 75,2 %, p=0,014). No hubo diferencias en el tiempo puerta balón entre los que recibieron ATC. El 48,6 % de los pacientes con PCR como forma de presentación tuvieron también Killip y Kimball (KK) D al ingreso. El uso de asistencia respiratoria mecánica (ARM) fue de 50,4 % vs 5,1 %, (p<0,001). La mortalidad intrahospitalaria de los pacientes con y sin paro cardiorrespiratorio (PCR) al ingreso fue del 50,5 % versus 4,6% respectivamente (p<0,001). La mortalidad de aquellos en K-K D con PCR de ingreso fue del 71 % y del 36 % en los K-K D que ingresaron sin dicha condición (p<0,001). En análisis multivariado la diabetes y el KK D fueron predictores independientes de PCR.

**Conclusión:** Uno de cada 7 pacientes con infarto con elevación del segmento ST que llega a los centros asistenciales se presenta con PCR. Los pacientes que ingresan con PCR tienen un perfil de riesgo más elevado, son menos reperfundidos y presentan más insuficiencia cardíaca, shock y uso de ARM que los que no lo presentan. La mitad de los pacientes con PCR como forma de presentación fallecen durante la internación, lo que se eleva a 7 de cada 10 pacientes si además se acompañan de KK D de ingreso. Es vital contar con personal entrenado tanto en la atención del PCR como en los cuidados post paro para intentar disminuir la mortalidad.

**Palabras clave:** Infarto - Paro Cardíaco - Registro

## INTRODUCTION

The ARGEN-IAM-ST registry includes patients with ST-segment elevation acute myocardial infarction (STEMI) lasting less than 36 hours. Maintained continuously for over 10 years by the Research Area of the Argentine Society of Cardiology and the Argentine Federation of Cardiology, this registry allows the analysis of various aspects of myocardial infarction in our country. (1,2)

Cardiac arrest (CA) is the most frightening and serious event in patients with STE acute coronary syndrome (ACS), (3) and it is responsible for half of all STEMI patients' deaths before hospital admission. (4) The most common underlying cause is the development of ischemia-induced ventricular tachycardia/ventricular fibrillation (VT/VF), (5) a condition that can be reversed with the use of a defibrillator. This underscores the importance of having defibrillators available in places with high concentrations of people and emergency services, since ACS is the most common cause of out-of-hospital CA. (6)

The aim of this study was to define and analyze the prevalence, characteristics, and in-hospital course of patients with CA as presenting symptom of STEMI who are transferred to hospital.

## METHODS

The database of patients included in the ARGEN-IAM-ST registry from March 2014 to March 2025 was analyzed.

Cardiac arrest was defined as the sudden cessation of cardiac activity that can lead to death if resuscitation measures are not taken or if they are unsuccessful. Cardiac arrest as presenting symptom of STEMI was considered when researchers checked the “presenting symptom” box in the presenting symptom section of the case record form. This form also documents the Killip and Kimball class on admission.

Cardiac arrest occurring after the first 24 hours of STE-

MI is recorded in the “in-hospital complications” section of the case record form and was not analyzed in this study.

**Inclusion criteria:** STEACS within 36 hours from the onset of symptoms.

**Exclusion criteria:** death before hospital admission, non-STEACS, CA resuscitated for a cause other than STEACS.

## Statistical analysis

The variables of interest were included in a frequency table. Quantitative variables with normal distribution were expressed as mean and standard deviation, and those with non-normal distribution as median and interquartile range (IQR) 25%-75%, and were compared using the Student's t-test or the Wilcoxon, according to their distribution. Qualitative variables were expressed as percentages and were compared using the chi-square test or Fisher's exact test, as appropriate.

A multiple logistic regression analysis was performed on variables with statistical differences and a p-value  $\leq 0.10$  between patients with and without CA. To define the independent predictors of the outcome, the strength of association of each variable with the response variable was expressed by its odds ratio (OR) and 95% confidence interval. A two-tailed p-value < 0.05 was considered statistically significant.

## Ethical considerations

The protocol design of the ARGEN-IAM-ST registry was evaluated and approved by the Committee on Bioethics of the Argentine Society of Cardiology, and was subjected to evaluations of the local committees, depending on the local regulations and institutional policies.

## RESULTS

A total of 7690 STEMI patients were included between March 2014 and April 2025. Then, 185 patients were excluded from the analysis because the box “CA as presenting symptom” was not checked (yes/no). Of the 7505 patients, 564 had CA as presenting symptom

(7.5%). Table 1 compares the baseline characteristics according to the presence or absence of CA on presentation.

Patients with CA as presenting symptom were older (median age of 62 vs. 61 years) and had a higher prevalence of diabetes, hypertension, coronary artery disease, peripheral vascular disease, and chronic obstructive pulmonary disease. Only 31.2% of patients with CA as presenting symptom were in Killip and Kimball (KK) class A on admission, compared to 80.1% of those who did not present with CA ( $p < 0.001$ ). Half of the patients with CA presented with KK class D, compared to only 4% of those who did not present with CA.

On coronary angiography, lesions of the left main coronary artery, left anterior descending coronary artery and multivessel disease were more common in patients presenting with CA. Nevertheless, reperfusion therapy and primary percutaneous coronary interventions (PCI) were less common in these patients (85.2% vs. 90.9% and 67.9% vs. 75.2%, respectively). All these differences were statistically significant. There were no differences in infarct location and door-to-balloon time between those patients undergoing PCI with or without CA on admission. Almost 50% of patients with CA as presenting symptom also had KK class D on admission. The use of mechanical ventilation (MV) was 50.4% vs. 5.1% ( $p < 0.001$ ). In patients with CA on admission, in-hospital mortality was 50.5% compared to  $< 5\%$  in the rest of the patients ( $p < 0.001$ ). Mortality in patients with KK class D and CA on admission was 71%, compared to 36% in KK class D patients without CA ( $p < 0.001$ ). Length of hospital stay was longer in patients who presented with CA.

Multivariate analysis using multiple logistic regression revealed that a history of diabetes (OR 1.32; 95% CI 1.051-1.668;  $p = 0.016$ ) and KK class D on admission (OR 21.593; 95% CI 17.052-27.343;  $p < 0.001$ ) were independently associated with CA as presenting symptom. (Table 2)

## DISCUSSION

The prevalence of CA as presenting symptom was 7.5% in our population, similar to that described in other population-based registries. (7-11) As described in other studies, (12, 13) STEMI patients presenting with CA have a higher clinical risk profile, including higher prevalence of diabetes, history of coronary artery disease and heart failure, and left main and multivessel coronary artery disease. In our case, they were also older. There were no differences in infarct location, and both groups had a high rate of reperfusion therapy use, although it was lower among patients with CA. Most patients underwent primary PCI, in accordance with standard guidelines, (14) with similar times to those of patients without CA. However, in-hospital mortality in CA patients was significantly higher (50%), consistent with the 40%-60% mortality rate reported in other studies (15,16).

This is in marked contrast to the 5% mortality rate observed in STEMI patients without CA, underscoring the critical role this event plays in infarction risk scores. (17) The high prevalence of cardiogenic shock (CS) on admission in the group of patients who presented with CA was a striking finding. It is important to note that CS can be due to different circumstances, including infarct size, a history of previous infarction, and myocardial dysfunction induced by the release of pro-inflammatory cytokines and catecholamine excess during CA, resuscitation, and return to spontaneous circulation. (18) This final possibility is supported by the observation that CS also develops in almost two-thirds of patients resuscitated from CA for any etiology, not just after AMI. (19-22) As in other studies, (23-25) the association of CA and CS resulted in higher mortality, which in our study reached 7 out of 10 patients in this situation. This further highlights the importance attributed to the presence of CA as a risk modulator in the SCAI classification of cardiogenic shock. (26) Factors associated with a worse prognosis in STEMI patients and CA include advanced age, delayed initiation of resuscitation maneuvers, the presence of asystole as initial rhythm, kidney injury, longer time to return to spontaneous circulation, and ventricular dysfunction on admission. The culprit vessel is also a relevant clinical determinant, since STEMI secondary to occlusion of the left anterior descending coronary artery is usually accompanied by worse outcomes due to the greater extent of myocardial damage. (27) Similarly, anterior wall infarction is recognized as an independent predictor of mortality in STEMI patients undergoing primary percutaneous coronary intervention. (28)

In our study, diabetes was an independent variable associated with CA on admission. While the evidence supporting this association is currently limited, the pathophysiological mechanisms involved include a greater extent of epicardial disease and microvascular coronary artery disease. This leads to a high incidence of non-reflux phenomenon and a lower rate of myocardial reperfusion, resulting in greater myocardial damage. (29)

Overall in-hospital mortality rate in our registry was 8%, and heart rhythm could be recorded in 97% of cases of CA. Our findings indicate that in 60% of these cases, CA was precipitated by VT/VF, a condition known to be associated with improved survival when accompanied by early defibrillation in both out-of-hospital and in-hospital cardiac arrests. This observation underscores the critical importance of continuous electrocardiographic monitoring of patients, as it directly impacts prognostic outcomes. (30-32)

Previously, it was thought that STEMI patients who experienced CA and survived the in-hospital stage had a similar prognosis to those without CA. (33) However, it is now known that these patients remain with a higher risk of death up to 30 and 90 days after the event. (34) Only after one year does this risk

**Table 1.** Baseline characteristics of the population according to the presence or absence of CA as presenting symptom.

	CA YES n = 564 7.5%	CA NO n = 6941 92.5%	p-value
Age	62 (56-71)	61 (53-69)	< 0.001
Male sex	433 (76.8)	5486 (79.0)	0.109
Diabetes	185 (32.8)	1858 (26.8)	0.001
Current smoking	197 (34.9)	2672 (38.5)	0.168
Dyslipidemia	224 (39.7)	2589 (37.3)	0.131
Hypertension	344 (61.0)	3712 (53.5)	<0.001
Obesity	105 (18.6)	1545 (22.3)	0.243
FH	67 (11.9)	1037 (14.9)	0.020
History of coronary artery disease	93 (16.5)	1037 (14.9)	0.021
History of heart failure	20 (3.5)	126 (1.8)	0.006
COPD	27 (4.8)	201 (2.9)	0.012
CKD	5 (0.9)	62 (0.9)	0.512
AF/AFL	3 (0.5)	26 (0.4)	0.332
Stroke	9 (1.6)	100 (1.4)	0.435
PVD	12 (2.1)	74 (1.1)	0.021
Anemia	5 (0.9)	22 (0.3)	0.047
Reperfusion	481 (85.2)	6312 (90.9)	<0.001
Anterior MI	230 (40.7)	2691 (38.8)	0.183
Primary PCI	383 (67.9)	5219 (75.2)	0.014
Fibrinolytic therapy	75 (13.3)	803 (11.6)	0.062
Both	48 (8.5)	522 (7.5)	0.124
Multivessel disease	182 (32.3)	2048 (29.5)	0.004
LAD culprit vessel	211 (37.4)	2783 (40.1)	<0.001
LMCA culprit vessel	29 (5.1)	53 (0.8)	<0.001
Door-to-balloon (min)	86 (44-148)	78 (45-135)	0.211
Door-to-needle (min)	28 (15-32)	30 (17-35)	0.585
KK A on admission	177 (31.24)	5563 (80.1)	<0.001
KK B on admission	85 (15.1)	964 (13.9)	<0.001
KK C on admission	13 (2.3)	98 (1.4)	<0.001
KK D on admission	274 (48.6)	274 (3.9)	<0.001
Requirements of MV	284 (50.4)	355 (5.1)	<0.001
KK D during hospitalization	284 (50.4)	432 (6.2)	<0.001
Length of hospital stay	4 (0-7)	4 (3-6)	<0.001
Death	285 (50.5)	319 (4.6)	<0.001

AF/AFL: atrial fibrillation/atrial flutter; CKD: chronic kidney disease; COPD: chronic obstructive pulmonary disease; FH: family history; KK: Killip and Kimball; LAD: left anterior descending coronary artery; LMCA: left main coronary artery; min: minutes; MV: mechanical ventilation; PCI: percutaneous coronary intervention; PVD: peripheral vascular disease.

Qualitative variables are presented as frequency and percentage, and quantitative variables are expressed as median and interquartile range.

equalize with that of patients who did not experience CA. (35) It is imperative to consider this aspect when developing post-discharge follow-up and personalized treatment strategies for this subgroup of patients, taking into account their clinical risk.

#### Study limitations

The data reported are derived from STEMI patients included in the continuous ARGENT-STEMI registry, which means that the centers are affiliated with scientific societies (SAC/FAC), and therefore may not

**Table 2.** Multivariate analysis. Predictors of clinical presentation with cardiopulmonary arrest in STEMI patients

Variable	OR	95% CI	p-value
Age	0.99	0.99-1.00	0.689
Diabetes	1.32	1.05-1.69	0.016
History of coronary artery disease	1.24	0.92-1.68	0.155
Reperfusion	0.84	0.46-1.51	0.559
Multivessel disease	0.89	0.71-1.12	0.330
KK class D on admission	21.60	17.05-27.34	<0.001

95% CI: 95% confidence interval; KK: Killip and Kimball; OR: odds ratio; STEMI: ST-segment elevation myocardial infarction

represent the reality of all patients in the country. Additionally, there is a lack of specific data regarding certain characteristics of CA, including whether it occurred in in-hospital or out-of-hospital contexts, the duration of resuscitation maneuvers, and whether the patient was lucid or comatose post-CA.

## CONCLUSION

One out of seven STEMI patients arriving at a health-care center presents with a CA as the initial manifestation. These patients have an elevated risk profile, are less likely to receive reperfusion treatment and exhibit an increased incidence of heart failure, shock, and longer length of hospital stay. More than half of patients presenting with CA die during hospitalization. This figure rises to 7 out of 10 in the presence of cardiogenic shock on admission. It is imperative to ensure the availability of defibrillators from the early stages of care to minimize the time to treatment in this potentially fatal complication.

## Conflicts of interest

None declared.

(See authors' conflict of interests forms on the web).

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