

## Original Article

## Prevalence, etiology, and characteristics of patients with type-2 acute myocardial infarction

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## ABSTRACT

**Background:** In clinical practice, type-1 (coronary thrombosis) and type-2 (imbalance between oxygen demand and supply) acute myocardial infarction (AMI) are not clearly differentiated. The aim of this study was to evaluate the prevalence and etiology of type-2 AMI and compare its profile with that of type-1 AMI. **Methods:** Patients admitted with ST-segment elevation AMI (STEMI) < 12 hours of symptom onset, and referred for coronary angiography, from 2009 to 2013, were analyzed.

**Results:** There were 1,960 patients included; 1,817 were analyzed, of whom 1,786 (98.3%) had type-1 AMI, and 31 (1.7%), type-2. All patients with type-2 AMI showed no significant coronary lesions, and 36% of the cases had apical dyskinesia. Type-2 AMI patients had, in general, a clinical and laboratory profile that was similar to those with type-1, except for the younger age, lower levels of myocardial necrosis markers, higher probability of having pre-TIMI 3 flow and higher left ventricular ejection fraction. At 30 days, mortality (3.2 vs. 9.0%;  $p = 0.23$ ) and the occurrence of death, reinfarction, or need for target-vessel revascularization (3.2 vs. 13.0%;  $p = 0.09$ ) were numerically lower in type-2 AMI.

**Conclusions:** Few patients with STEMI were classified as type-2; they had structural abnormalities, isolated or associated with the absence of significant lesions; showed little difference regarding the clinical and laboratory profile, and similar clinical outcomes at 30 days, when compared to patients with type-1 AMI.

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## Prevalência, etiologia e características dos pacientes com infarto agudo do miocárdio tipo 2

## RESUMO

**Introdução:** Na prática clínica, os tipos 1 (trombose coronariana) e 2 (desequilíbrio entre a demanda e oferta de oxigênio) de infarto agudo do miocárdio (IAM) não são claramente distinguidos. O objetivo deste estudo foi avaliar a prevalência e a etiologia do IAM tipo 2, e comparar seu perfil com o do tipo 1.

**Métodos:** Foram analisados pacientes admitidos com IAM com supradesnívelamento do segmento ST (IAMCST) com < 12 horas, encaminhados para coronariografia, no período de 2009 a 2013.

**Resultados:** Foram incluídos 1.960 pacientes, sendo 1.817 analisados, dos quais 1.786 (98,3%) com IAM tipo 1 e 31 (1,7%) do tipo de 2. Todos os pacientes com IAM tipo 2 apresentaram coronárias sem lesões significativas e, em 36% dos casos, discinesia apical. Os pacientes com IAM tipo 2 apresentaram, em geral, perfil clínico e laboratorial semelhante aos do tipo 1, com exceção da idade mais jovem, menores níveis de marcadores de necrose miocárdica, maior probabilidade de apresentarem fluxo TIMI 3 pré e maior fração de ejeção do ventrículo esquerdo. Aos 30 dias, a mortalidade (3,2 vs. 9,0%;  $p = 0,23$ ) e a ocorrência de morte, reinfarto ou necessidade de revascularização do vaso-alvo (3,2 vs. 13,0%;  $p = 0,09$ ) foram numericamente menores no IAM tipo 2.

**Conclusões:** Uma pequena fração de pacientes com IAMCST foi classificada como de tipo 2; exibiram anormalidades estruturais isoladas ou associadas à ausência de lesões significativas; mostraram poucas diferenças no perfil clínico e laboratorial, e desfechos clínicos semelhantes aos 30 dias, comparados aos pacientes com IAM tipo 1.

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## Introduction

Data from the Department of Informatics of the Unified Health System (DATASUS) 2013 show that acute myocardial infarction (AMI) was the main cause of death from heart disease in Brazil, with an increase of 48% observed between 1996 and 2011.<sup>1</sup> If this trend persists, it is expected that AMI will become the main isolated cause of death by 2020.<sup>2</sup>

The universal definition jointly developed by the European Society of Cardiology (ESC), American College of Cardiology Foundation (ACCF), American Heart Association (AHA), and World Heart Federation (WHF) subdivides AMI into five types.<sup>3,4</sup> Type-1 AMI is a spontaneous event, resulting from coronary thrombosis, which results, in turn, from disruption, fracture, or erosion of the atherosclerotic plaque.<sup>5,6</sup> The imbalance between oxygen demand and supply characterizes type-2 AMI, which occurs in several conditions not associated with atherosclerotic plaque events. This imbalance can occur due to endothelial dysfunction, coronary vasospasm, coronary embolism, tachyarrhythmias and bradyarrhythmias, anemia, respiratory failure, hypotension, and hypertension, with or without left ventricular hypertrophy. The other types include type-3 AMI, which is defined when patients suffer cardiac death, with symptoms suggestive of myocardial ischemia, accompanied by presumed new ischemic electrocardiographic changes or new left bundle branch block, but without available biomarker values. Type-4A is associated with percutaneous coronary intervention, and type 4B occurs in the presence of stent thrombosis. Type-5 characterizes the AMI associated with coronary artery bypass surgery.

In clinical practice, type-1 and type-2 AMI are not clearly differentiated,<sup>7</sup> and the electrocardiographic and biochemical characteristics can be similar.<sup>8,9</sup> Thus, the aim of this study was to evaluate the prevalence and etiology of type-2 AMI, compare the risk factors, clinical and laboratory characteristics, and outcomes of these patients with those of type-1, in a cohort of patients undergoing coronary angiography for ST-segment elevation AMI (STEMI) in a referral cardiology hospital.

## Methods

All patients were prospectively and sequentially enrolled at the hospital emergency department with STEMI, with < 12 hours of symptom onset, and submitted to coronary angiography in the period from December 2009 to December 2013. The exclusion criteria included the patient's refusal to participate the study and age < 18 years. The project was approved by the local research ethics committee. All patients or their family members signed an informed consent. The initial interview with the patient, carried out upon arrival at the hospital emergency department, included the recording of demographic data, risk factors for ischemic heart disease, and clinical presentation of the event.

STEMI was defined by electrocardiographic abnormalities (presence of new, or presumably new, ST-segment elevation > 0.1 mV in two or more contiguous leads), clinical presentation consistent with acute ischemia, and increase in myocardial necrosis markers (myocardial isoenzyme of creatine kinase - CK-MB with at least one value above the 99<sup>th</sup> percentile upper reference limit or, in the absence of CK-MB, total CK greater than twice the upper limit of normal, or troponin elevation) within the 24 hours of symptom onset.<sup>10</sup> Hypertension, diabetes mellitus, and dyslipidemia were classified according to the Guidelines of the Brazilian Society of Cardiology.<sup>11-13</sup> The criterion used for family history of coronary artery disease (CAD) was the occurrence of AMI in first-degree male relatives younger than 55 years or in females younger than 65 years.<sup>14</sup>

Medications used in the initial patient care consisted of acetylsalicylic acid, loading dose of 300 mg, and clopidogrel 300 to 600 mg, administered immediately after the patient's arrival in the emergency room. Unfractionated heparin at a dose of 70 to 100 IU/kg was used in the emergency or cath lab room.

Angiographic evaluations were performed using a previously validated digital electronic system. The number of vessels with lesions > 50%, the culprit vessel, and the presence of coronary calcification were assessed. The AMI-type classification was performed after the angiography, by the interventionalists, according to the previously mentioned criteria.<sup>3,4</sup> All patients' images and reports were reviewed to confirm type-2 AMI, and to assess other angiographic findings.

Patient follow-up was performed during hospital stay and after discharge, by telephone contact at 30 days.

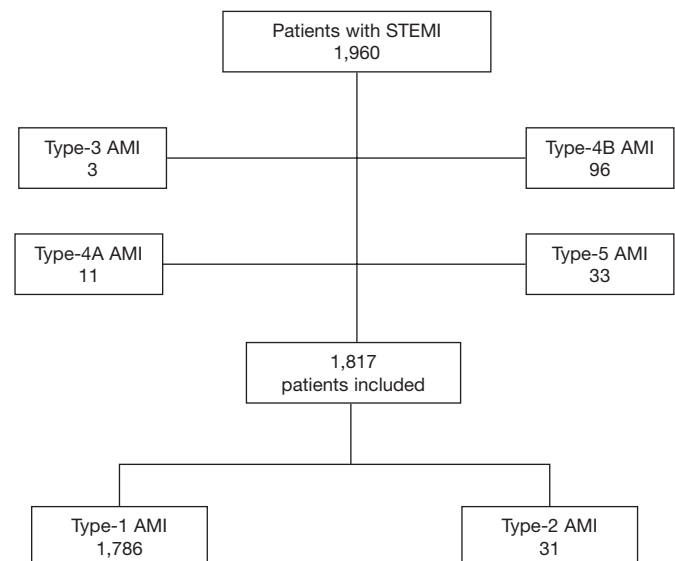
## Statistical analysis

Categorical variables were expressed as frequencies and percentages, and were compared with the Chi-squared test or Fisher's exact test. Quantitative variables were expressed as mean and standard deviation, or median and interquartile range, and compared by analysis of variance (ANOVA) or the Tukey test for multiple comparisons, in the case of normal distribution, or the Kruskal-Wallis test for asymmetric distribution of variables. Data were analyzed using Statistical Package for the Social Sciences (SPSS) for Windows, version 19.0 (IBM Corp., Armonk, USA). The values considered significant were those with  $p < 0.05$ .

## Results

During the described period, 1,960 patients were assessed and 1,817 were included in this study: 1,786 (98.3%) with type-1 AMI and 31 (1.7%) with type-2 AMI (Fig. 1).

All patients with type-2 AMI had coronaries with absence of or no significant lesions. Additional findings included apical dyskinesia in 35.5% of cases, coronary tortuosity and left ventricular hypertrophy in 32.3%, and 22.6% with normal coronary arteries. One case of intramyocardial bridge (3.2%), another of cardiomyopathy (3.2%), and a third of aortic stenosis (3.2%) were also observed (Fig. 2).



**Figure 1.** Study flow chart. STEMI: ST-elevation myocardial infarction; AMI: acute myocardial infarction.

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