

Critical Analysis of the Clinical and Lipidic Profile of Patients with Acute Coronary Syndrome in a Public Hospital in São Paulo

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Abstract

Background: Myocardial infarction (MI) is highly influenced by risk factors such as dyslipidemia. Achieving low-density lipoprotein cholesterol (LDL-C) goals is key to reducing the residual cardiovascular risk. However, the proportion of patients with MI who accomplish this goal is unknown.

Objective: Assess risk factors, lipid profile evolution from admission to the first outpatient consultation, and the therapy administered.

Methods: This is a descriptive study of patient charts from a public hospital in São Paulo from June 2021 to March 2022. The statistical analyses employed were the Chi-square test and the paired t-test, with significance defined as p-values < 0.05.

Results: ST-elevation MI (STEMI) occurred in 61% of the patients. Among the patients with previous MI, 50% did not use statins. There was a correlation between STEMI and no statin use ($p < 0.05$). At hospital discharge, 12%, 17%, and 13% lacked prescriptions for aspirin, clopidogrel, and statins, respectively. At the first outpatient consultation, only 8% of patients with available data reached the absolute LDL-C goal of <50 mg/dL. Only 9% of patients had their cholesterol levels assessed at admission and at the first outpatient consultation, while 26.7% of those achieved at least a 50% LDL-C reduction. The mean LDL-C reduction was 25% ($p < 0.05$).

Conclusion: Considering the severity of the assessed patients, the cardiovascular risk stratification was ineffective, the pharmacologic therapy was not optimized, and the achievement of the LDL-C goals according to guidelines was unsatisfactory in this population.

Keywords: LDL Cholesterol; Hydroxymethylglutaryl-CoA Reductase Inhibitors; Lipids.

Introduction

Cardiovascular diseases represent a significant public health challenge. According to data from the Department of Informatics of the Unified Health System (DATASUS) in 2019, 7.08% (95,557 patients) of all deaths were attributed to Acute Myocardial Infarction (AMI), making it the leading cause of death in Brazil.¹

The pathophysiology of coronary artery obstruction is intrinsically linked to the deposition of cholesterol particles in the intimal layer of the vessel.² Furthermore, it is important to note that this process occurs proportionally to the plasma cholesterol concentration.³ Studies have demonstrated that as serum cholesterol levels decrease, the likelihood

of cardiovascular events also diminishes.⁴ For this reason, current guidelines from the Atherosclerosis Department of the Brazilian Society of Cardiology (SBC-DA),³ as well as recommendations from European,⁵ American,⁶ and Canadian societies,⁷ advocate for establishing LDL-c targets based on the absolute cardiovascular risk.⁸

The current goals established by the SBC-DA³ for patients classified as very high risk are a low-density lipoprotein cholesterol (LDL-C) level of <50 mg/dL or a >50% reduction. Plasma cholesterol testing should ideally be performed on two specific occasions: during the acute phase and at the first follow-up visit. The first LDL-c measurement should be obtained within the first 24 hours of the acute event, as plasma cholesterol concentrations tend to decrease after this period, potentially impairing the accurate interpretation of the results. The second must be approximately three months later.⁹⁻¹²

To improve lipid parameters, it is essential to adopt a healthier lifestyle, including regular physical exercise, a balanced diet, reduced alcohol consumption, and smoking cessation. Pharmacological treatment plays a crucial role in lowering cholesterol levels, with statins being the primary drugs used in both primary and secondary prevention.^{3,4}

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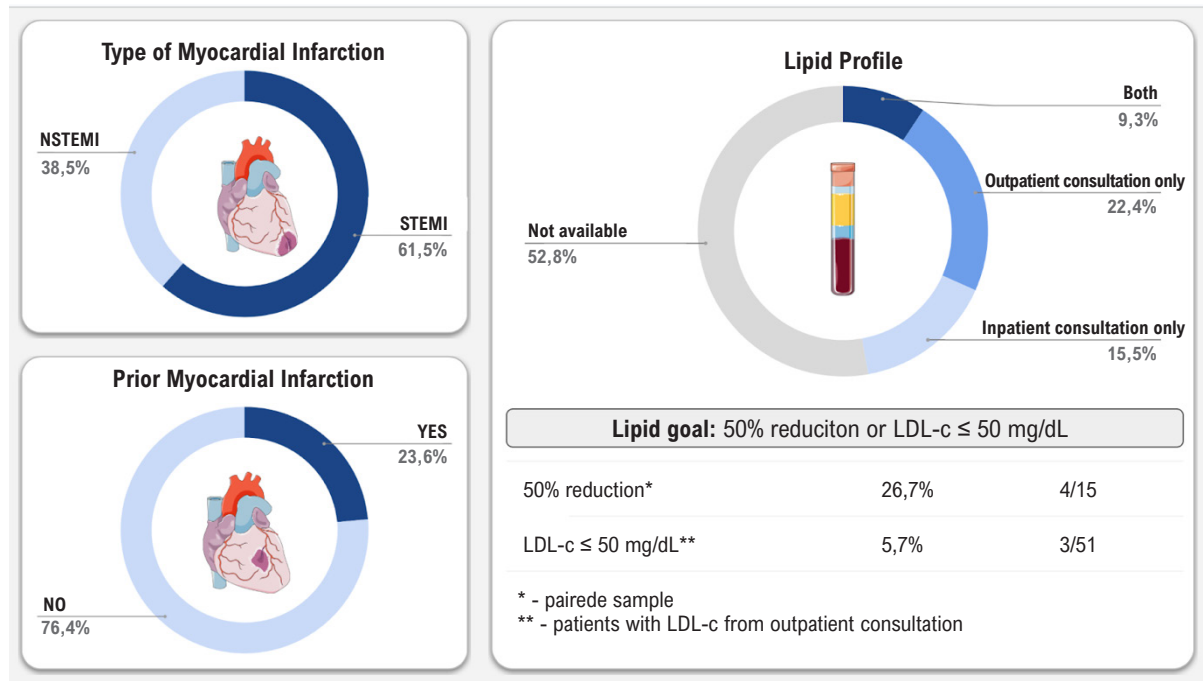
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Central Illustration: Critical Analysis of the Clinical and Lipidic Profile of Patients with Acute Coronary Syndrome in a Public Hospital in São Paulo



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The proportion of patients at very high cardiovascular risk or those who have experienced AMI who achieve the LDL-c levels recommended in the guidelines is not well established. Additionally, it is unclear whether this patient group is being effectively treated, as access to high-potency statins remains limited within the public healthcare system. Monitoring cholesterol levels and gaining a better understanding of residual cardiovascular risk in this population could not only address the therapeutic gap but also enhance the potential to optimize cardiovascular risk management at both the individual and population levels.

Thus, the study aimed to evaluate cardiovascular risk factors, the timing of blood sample collection, lipid profile evolution, achievement of LDL-c targets, and the therapeutic strategies employed in patients with AMI at a public hospital.

Methods

A descriptive observational study was conducted using electronic medical records from the electronic patient registration platform of a public hospital in São Paulo. The study included patients diagnosed with AMI between June 2021 and March 2022.

Patients aged 18 years or older, of both sexes, with the International Classification of Diseases code for AMI (ICD-10 I21), who sought the hospital as their first point of care

were included. Patients primarily treated at another facility or with a diagnosis other than AMI were excluded.

Plasma LDL levels were collected during hospitalization for the acute event and at the first follow-up visit. It was not possible to obtain laboratory results before the acute event because these patients had not been followed up at the hospital.

The study was approved by the Research Ethics Committee and an academic institution, with a waiver for obtaining informed consent.

Statistical analysis

The data collected were analyzed using absolute values, means, and percentages. The categorical variables assessed were sex, previous myocardial infarction (MI), hypertension, dyslipidemia, smoking, previous diabetes mellitus, history of coronary artery disease, chronic kidney disease, and death. The continuous variables assessed were age, body mass index (BMI), and serum LDL-c. Standard deviation was the measure of dispersion used for all continuous variables.

The Shapiro-Wilk test was used to assess the distribution of the sample. The Chi-square test was employed to assess the association between risk factors and the type of AMI. To compare LDL-c levels between hospitalization and the first follow-up, a paired Student's t-test was used. A p-value of <0.05 was considered statistically significant. R (R Foundation

for Statistical Computing, Vienna, Austria) version 4.4.3 was used for statistical analyses.

Results

A total of 872 medical records with ICD-10 code I21 were analyzed from June 2021 to March 2022. Of these, 711 were excluded because they lacked an acute coronary event or failed to meet the inclusion criteria (Figure 1).

The Shapiro-Wilk test did not show a significant departure from normality, $W(161) = .99$, $p = .488$.

The mean age of the sample was 61.4 years, with a standard deviation of 11.3 years. Male patients were predominant (67%). STEMI was the most prevalent type of AMI, accounting for 61% of the cases (Central Illustration). Regarding mortality, 8.7% of patients succumbed, most of them due to STEMI (Table 1). Additionally, 19% of the AMI events occurred in patients under 50 years of age. The mean body mass index (BMI) was 27.7 kg/m^2 , with a standard deviation of 3.5 kg/m^2 . However, anthropometric data were missing in 52% of the electronic medical records.

Regarding risk factors, 24% of the patients had a history of prior AMI, yet only 50% of these were on regular statin therapy (Central Illustration). Additionally, 50% of the total sample were smokers, 61% were hypertensive (with higher prevalence among men), and 28% were aware of having type 2 diabetes mellitus (T2DM). However, 58% of the population without a prior diagnosis of T2DM exhibited glycemic levels $>140 \text{ mg/dL}$ during hospitalization. Only 10.55% were aware of having dyslipidemia, and 5% reported a family history of premature atherosclerotic disease (Table 1).

Concerning sex differences, male patients showed higher rates of hypertension. However, no significant differences were observed in the type of AMI or the incidence of other risk factors (Table 2).

Regarding lipid profile monitoring, the ideal approach would be to perform lipid panel measurements at two key time points for all patients: 1) during the acute phase of acute myocardial infarction (AMI), preferably within 24 hours, and 2) during the first follow-up visit, approximately three months later. The total sample was divided into four groups according to the timing of lipid profile testing, with 53% of patients not undergoing testing at either time point (Figure 2).

Among the 25% who were tested during hospitalization (the sum of the 9% and 16% in Figure 3), the mean LDL-c value was $111.1 \pm 38.3 \text{ mg/dL}$, measured 4.2 ± 0.7 days after the acute event. It is noteworthy that the distribution of these patients predominantly shows higher LDL-c values at admission, particularly above 100 mg/dL (Figure 3).

Among the 31% who were tested at the follow-up visit (the sum of 9% and 22% in Figure 2), the mean LDL-c value was $88.6 \pm 29 \text{ mg/dL}$, with an average time of 87.5 ± 10 days after the post-event consultation.

Among the 9% who had lipid profile testing at both time points, it is possible to subtract the values obtained during hospitalization from those obtained during the follow-up visit, yielding an average reduction of 31.78 mg/dL (Figure 4). Performing a paired Student's t-test, the p-value < 0.05 indicates statistical significance. The reduction was, on average, 28.6%.

Of the patients tested at both time points, only 26.7% achieved the target of a 50% reduction in baseline LDL-c (Central Illustration). Conversely, 20% of these patients experienced an increase in LDL-c concentrations.

Regarding medication prescriptions at hospital discharge, 12%, 17%, and 13% of the sample did not receive acetylsalicylic acid (ASA), clopidogrel, or statins, respectively, and there were no records of possible contraindications to these medications.

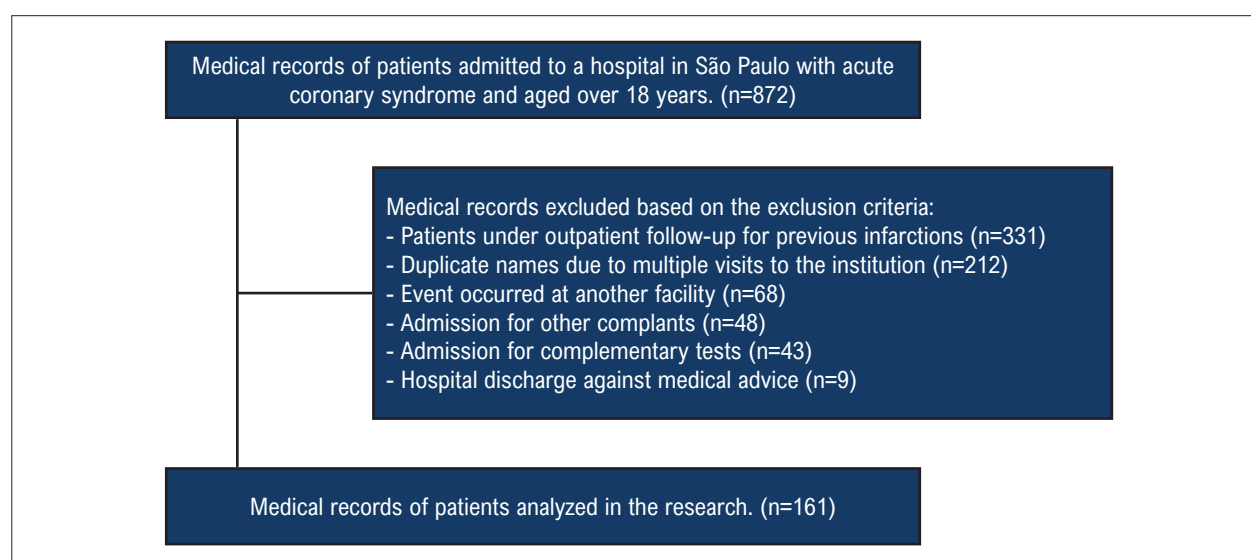


Figure 1 – Flowchart illustrating participant exclusion from the final study sample. Source: The authors.

Table 1 – Clinical profile according to the type of AMI

Variables	STEMI (n=99)	NSTEMI (n=62)	p value
Age, SD	61.1 ± 12.0	62.0 ± 10.6	
BMI, SD	28.3 ± 5	26.8 ± 5	
Male sex, n (%)	71 (44%)	37 (23%)	.16
Female sex, n (%)	28 (17%)	25 (16%)	.16
Previous AMI, n (%)	16 (10%)	22 (14%)	< .01
Previous statin use, n (%)	14 (9%)	23 (14%)	< .01
No previous statin use, n (%)	85 (53%)	39 (24%)	< .01
Systemic arterial hypertension, n (%)	53 (33%)	45 (28%)	.02
Dyslipidemia, n (%)	10 (6%)	7 (4%)	.98
Current or previous smoking, n (%)	51 (32%)	30 (19%)	.82
DM Previous diagnosis, n (%)	28 (17%)	17 (11%)	.77
No previous diagnosis with blood glucose > 140mg/dL, n (%)	59 (37%)	35 (22%)	.77
Family history of coronary artery disease, n (%)	4 (2%)	4 (2%)	.75
Chronic kidney disease, n (%)	2 (1%)	8 (5%)	.01
Death, n (%)	10 (6%)	4 (2%)	.61

STEMI: ST-segment elevation myocardial infarction; NSTEMI: non-ST-segment elevation myocardial infarction; SD: standard deviation; BMI: body mass index; AMI: acute myocardial infarction; DM: diabetes mellitus. Source: The authors.

Table 2 – Clinical profile according to sex

Variables	Female (n = 53)	Male (n = 108)	p value
Age, SD	62.9 ± 12.3	60.7 ± 11.0	
BMI, SD	28.5 ± 5.9	27.2 ± 4.4	
Under 40 years old, n (%)	2 (1%)	5 (3%)	.76
40 to 50 years old, n (%)	9 (6%)	15 (9%)	.76
50 to 60 years old, n (%)	8 (5%)	29 (18%)	.76
60 to 70 years old, n (%)	19 (12%)	43 (27%)	.76
Over 70 years old, n (%)	38 (24%)	92 (57%)	.76
Previous AMI, n (%)	13 (8%)	25 (16%)	.99
Previous statin use, n (%)	11 (7%)	26 (16%)	.78
No previous statin use, n (%)	42 (26%)	82 (51%)	.78
Systemic arterial hypertension, n (%)	41 (25%)	57 (35%)	< .01
Dyslipidemia, n (%)	5 (3%)	12 (7%)	.96
Current or previous smoking, n (%)	27 (17%)	54 (34%)	.96
DM			
Previous diagnosis, n (%)	17 (11%)	28 (17%)	.47
No previous diagnosis with blood glucose > 140mg/dL, n (%)	31 (19%)	63 (39%)	.47
Family history of coronary artery disease, n (%)	3 (2%)	5 (3%)	.92
Chronic kidney disease, n (%)	3 (2%)	7 (4%)	.89
Death, n (%)	5 (3%)	9 (6%)	.95

SD: standard deviation; BMI: body mass index; AMI: acute myocardial infarction; DM: diabetes mellitus. Source: The authors.

Original Article

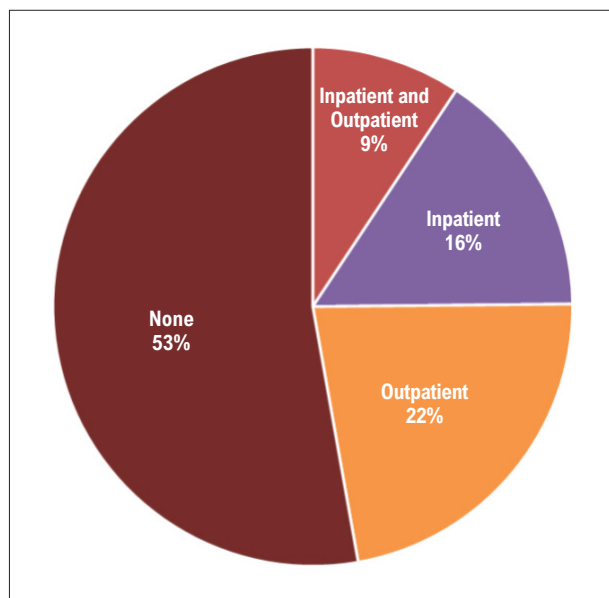


Figure 2 – Period of LDL-c test collection after AMI. Source: The authors.

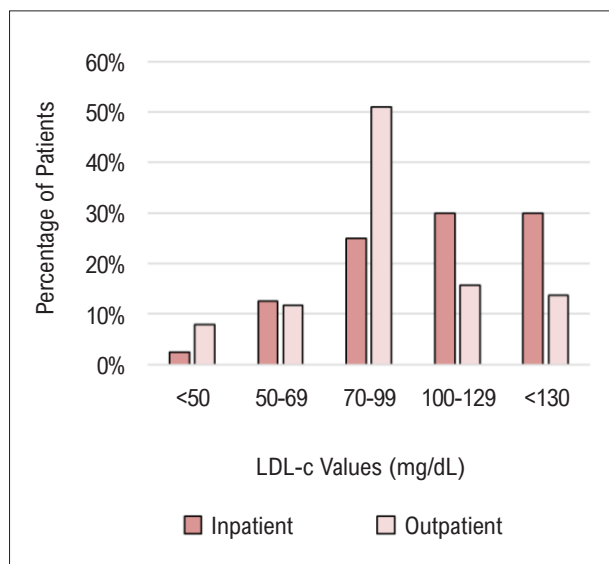


Figure 3 – Distribution of LDL-c levels during hospitalization and follow-up. Source: The authors.

Discussion

The management of high-risk and very high-risk patients, such as those with AMI, should be as effective and comprehensive as possible, as these patients have high morbidity and mortality rates. Achieving cholesterol targets is crucial to reducing the residual risk in these individuals. Thus, LDL-c levels < 50 mg/dL have been shown to provide significant clinical benefit without increased adverse events.¹³

In this regard, studies with fixed combinations of lipid-lowering agents —statin and ezetimibe (IMPROVE-IT)

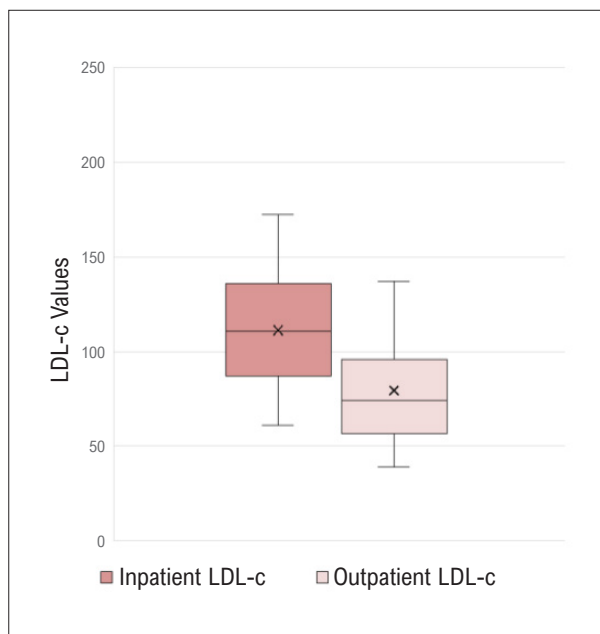


Figure 4 – Distribution of LDL-c values in a paired sample during hospitalization and follow-up. Source: The authors.

or PCSK9 inhibitors, statins, and/or ezetimibe — have significantly improved primary clinical outcomes (death, AMI, stroke). In the IMPROVE-IT, FOURIER, and ODISEY-OUTCOMES trials, LDL-c concentrations reached 54, 32, and 32 mg/dL, respectively.¹³⁻¹⁵

In our research, we evaluated how the treatment offered to this group of individuals aligns with real-world clinical practice.

The average age of our sample (61.4 years) is consistent with DATASUS data on AMI hospitalizations in Brazil (60-69 years). The predominant sex in both our sample and the DATASUS data is male, as seen in the Brazilian Society of Cardiology Guidelines on Unstable Angina and Acute Myocardial Infarction without ST-Segment Elevation.¹⁶ It is noteworthy that both the literature and clinical practice data indicate that affected individuals are relatively young. This likely reflects inadequate cardiovascular risk stratification, and risk factor prevention may not be optimized.

The objective evaluation of lipid-lowering therapy was performed by comparing LDL-c values at hospitalization and at follow-up. However, 53% of patients did not have LDL-c measurements during hospitalization for the acute event, hindering analysis of lipid progression in this group.

The timing of lipid profile testing during hospitalization, often more than 24 hours after the acute event, likely led to an underestimation of LDL-c levels and failed to reflect the true severity of this patient group. Still, the values obtained during hospitalization were mostly above 100 mg/dL. These possibly underestimated values could explain the increase in LDL-c concentrations observed in 20% of the sample at follow-up, even though statins were being used, as lipid levels might have already reached their true levels by then.

The mean post-AMI LDL-c concentration in our study (88.6 mg/dL) was similar to the value reported by Bernardi et al.¹⁷ (92.2 mg/dL) in a public health system in Curitiba.

Regarding lipid testing after approximately 90 days following AMI, our study's 31% result contrasts with the 44% reported by Wang et al.¹⁸ Nevertheless, both figures still fall short of guideline recommendations for lipid monitoring in this population.

Regarding achieving target LDL-c values, only 8% of patients reached an LDL-c level < 50 mg/dL, and 12% reached an LDL-c level < 70 mg/dL at the follow-up visit, which occurred on average 87 days after the AMI event. This interval is considered appropriate for lipid normalization after the acute event.

When evaluating the percentage reduction in LDL-c as recommended by the guideline,³ it is important to highlight that the majority of patients did not meet the lipid target, with an average reduction of 25%, which is similar to the findings in Curitiba,¹⁷ 24,3%.

With the use of simvastatin 40 mg/day, which was prescribed to most patients at hospital discharge, the sample should have achieved a reduction of up to 38%, which still falls short of the ideal target of 50%. It is worth mentioning that high-potency statins are classified as high-cost medications in the Brazilian public health system (SUS), limiting their prescription for all patients who need them.

Furthermore, statin prescription was not optimized, as not all patients received statins, which also contradicts the guidelines recommending statin therapy for all very high-risk patients, unless contraindicated.¹⁶ Despite this, patients who did not receive statins had higher rates of STEMI, suggesting more severe events compared to those who were prescribed statins. This suggests that, even if lipid targets are not met, statin use is associated with better cardiovascular outcomes than non-use (Table 1).

Among the factors that may contribute to the high proportion of patients with inadequate LDL-C control following MI, notable issues include limited access to specialist follow-up care, which undermines both laboratory monitoring and the appropriate intensification of lipid-lowering therapy. Additionally, poor adherence to lifestyle modifications and prescribed pharmacologic regimens, often stemming from insufficient awareness of the importance of strict LDL-C control in the secondary prevention of cardiovascular events, further complicates disease management. The unavailability or high cost of high-potency therapies, such as PCSK9 inhibitors, particularly within public healthcare systems, represents a major barrier to the implementation of more effective therapeutic interventions, thereby perpetuating the elevated residual cardiovascular risk in this population.

To enhance treatment adherence among patients with STEMI, strategies that address educational, structural, and therapeutic dimensions are key. Implementing health education programs that clearly communicate the severity of the disease, the risk of recurrence, and the benefits of treatment adherence can significantly improve patient engagement. Moreover, multidisciplinary follow-up provides

continuous and personalized support. Finally, strengthening primary care and outpatient follow-up by using telephone or app-based reminders can reduce follow-up loss and improve long-term therapeutic persistence.

This study aimed to reflect our daily clinical practice in the management of very high-risk patients with AMI in a big city in Brazil, who represent a considerable proportion of individuals with high morbidity and mortality rates. The challenges faced in prescribing high-potency statins, such as rosuvastatin and atorvastatin, as well as the combination of simvastatin with ezetimibe in emergency services and outpatient care in SUS, contribute to increased residual cardiovascular risk in this patient group. The research also underscores the need for lipid profiling within 24 hours of the acute event to provide reliable data reflecting the patient's lipid profile.

Limitations

The data for this study were obtained from electronic medical records. Therefore, not all data were complete for the patients included in the study. It was not possible to accurately assess lipid target achievement due to the lack of lipid profile testing in all patients during hospitalization for AMI and at the follow-up visit. Additionally, the lipid tests performed during hospitalization likely underestimated LDL-C levels due to delays in collection. Finally, the sample was limited to a single medical center.

Conclusion

Despite the high severity of the sample, the data suggest a failure to document or assess the risk factors of these patients. Lipid profile testing during the acute phase of AMI was inadequate and performed outside the time frame recommended by major guidelines. Most patients did not achieve the recommended LDL-c target of <50 mg/dL after statin therapy. The use of statins was insufficient, as there are still restrictions on prescribing high-potency statins in the SUS.

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Author Contributions

Conception and design of the research and Analysis and interpretation of the data: Costa GR, Cavalcante LFF, Alves RJ; Acquisition of data, Statistical analysis and Writing of the manuscript: Costa GR, Cavalcante LFF; Obtaining financing: Costa GR, Alves RJ; Critical revision of the manuscript for content: Alves RJ.

Potential conflict of interest

No potential conflict of interest relevant to this article was reported.

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Study association

This study is not associated with any thesis or dissertation work.

Ethics approval and consent to participate

This study was approved by the Ethics Committee of the Santa Casa de Misericórdia de São Paulo under the protocol

number 58766222.6.0000.5479. All the procedures in this study were in accordance with the 1975 Helsinki Declaration, updated in 2013.

Use of Artificial Intelligence

The authors did not use any artificial intelligence tools in the development of this work.

Data Availability Statement

The underlying content of the research text is contained within the manuscript.

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