

Management of multivessel coronary disease after primary angioplasty: staged reintervention versus optimized clinical treatment and two-year follow-up

Manejo da doença coronária multiarterial após angioplastia primária: reintervenção estadiada versus tratamento clínico otimizado e seguimento de 2 anos

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Abstract

Objective: In the clinical scenario of ST-segment elevation acute myocardial infarction, several patients with multivessel coronary atherosclerotic disease are discharged without a defined strategy to monitor the residual atherosclerotic lesions. The clinical endpoints evaluated were cardiovascular death, symptoms of angina pectoris, rehospitalization for a new acute coronary syndrome, and the necessity of reintervention during the two-year follow-up.

Methods: This observational, prospective, and historical study included multivessel coronary atherosclerotic disease patients who were admitted to a tertiary care university hospital with ST-segment elevation acute myocardial infarction and underwent primary percutaneous coronary intervention with stent implantation only at the culprit lesion site; these patients were monitored in the outpatient clinic according to two treatments: the Clinical Group - CG (optimized pharmacological therapy associated with counseling for a healthy diet and cardiac rehabilitation) or the Intervention Group - IG (new staged percutaneous coronary intervention or surgical coronary artery bypass graft surgery combined with the previously prescribed treatment).

Results: Of 143 patients consecutively admitted with ST-segment elevation acute myocardial infarction, 57 were eligible for

the study (CG=44 and IG=13). Regarding the clinical endpoints, the cardiovascular death rate did not differ between the CG and IG. The symptom of angina pectoris and the rehospitalization rate for a new episode of acute coronary syndrome were accentuated in the CG ($P=0.020$ and $P=0.049$, respectively) mainly in individuals with evidence of ischemia evidenced by myocardial scintigraphy ($P<0.001$ and $P=0.001$, respectively) which culminated in an even greater need for reintervention ($P=0.001$) in this subgroup of patients.

Conclusion: The staged intervention was demonstrated to be safe and able to reduce angina pectoris and rehospitalization for a new episode of acute coronary syndrome. In addition, it decreases the likelihood of unplanned reinterventions of patients without ischemia evidenced by myocardial scintigraphy.

Descriptors: Myocardial infarction. Coronary disease. Angioplasty. Scintigraphy. Mortality.

Resumo

Objetivo: No cenário do Infarto Agudo do Miocárdio com Supradesnível do Segmento ST, diversos pacientes com doença coronária aterosclerótica multiarterial recebem alta hospitalar

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Abbreviations, Acronyms & Symbols	
STEMI	ST-segment elevation acute myocardial infarction
MCAD	Multivessel Coronary Atherosclerotic Disease
ACS	Acute Coronary Syndrome
PCI	Percutaneous Coronary Intervention
CG	Clinical Group
IG	Intervention Group
CAD	Coronary Artery Disease
BARI	Bypass Angioplasty Revascularization Investigation

sem estratégia definida para seguimento de coronariopatia residual. Avaliamos o desfecho composto por morte cardiovascular, sintoma de angina de peito, reinternação por nova síndrome coronária aguda ou necessidade de reintervenção no seguimento de dois anos.

Métodos: Estudo observacional, prospectivo, histórico, incluindo portadores de doença coronária aterosclerótica multiarterial admitidos em serviço terciário universitário com Infarto Agudo do Miocárdio com Supradesnível do Segmento ST submetidos à intervenção coronária percutânea primária com implante de stent apenas na lesão culpada e conduzidos ambulatorialmente conforme duas terapêuticas: Grupo Clínico - GC (terapia far-

macológica otimizada associada à orientação dietética saudável e reabilitação cardiovascular) ou Grupo Intervenção - GI (nova ICP estadiada ou revascularização miocárdica cirúrgica aliada ao tratamento previamente descrito).

Resultados: De 143 pacientes consecutivamente admitidos com Infarto Agudo do Miocárdio com Supradesnível do Segmento ST, 57 foram elegíveis para o estudo (GC=44 e GI=13). Em relação aos desfechos, o GI não diferiu do GC quanto à taxa de óbito cardiovascular. O sintoma de angina de peito e a taxa de reinternação por novo episódio de síndrome coronária aguda destacam-se no GC ($P=0,020$ e $P=0,049$; respectivamente), principalmente nos indivíduos com evidência de isquemia à cintilografia miocárdica ($P<0,001$ e $P=0,001$; respectivamente) culminando, inclusive, com maior necessidade de reintervenção ($P=0,001$) neste subgrupo de pacientes.

Conclusão: A intervenção estadiada mostra-se segura e capaz de reduzir angina de peito e reinternação por novo episódio de síndrome coronária aguda. Além disso, diminui a probabilidade de reintervenções não planejadas em pacientes com ausência de isquemia à cintilografia miocárdica.

Descritores: Infarto do Miocárdio. Doença das Coronárias. Angioplastia. Cintilografia; Mortalidade.

INTRODUCTION

The primary percutaneous coronary intervention (PCI) for exclusive treatment of the culprit lesion in an acute ischemic event remains in the current guidelines^[1-3] as the strategy recommended for managing patients with ST-segment elevation acute myocardial infarction (STEMI) who are hemodynamically stable. Although retrospective records and multicenter clinical trials demonstrate the occurrence of multivessel coronary atherosclerotic disease (MCAD) in approximately 40 to 65% of these individuals^[4-7] and even a poor prognosis associated with this diffuse atherosclerotic involvement, several scientific pieces of evidence support this recommendation^[8-13].

However, these guidelines do not include clear recommendations for managing residual MCAD after angiographic success in primary PCI. In addition, information from national records^[14,15] involving patients with MCAD admitted with STEMI and who underwent primary PCI do not specify strategies to monitor significant residual lesions that are not treated in the initial procedure.

Considering the worldwide evidence that indicates a reduced number of surgical revascularizations compared with a simultaneous and significant increase in the percutaneous

approaches, with or without coronary stent implantation^[16], concepts such as cost-effectiveness and ischemia-free survival or re-intervention justify the real concern of the assistant cardiologist regarding the appropriate clinical monitoring of these patients. In this context, a recent review published by Andrade et al.^[17] demonstrated that the comparison between percutaneous and surgical revascularization approaches is controversial even when it is based only on the most robust randomized clinical trials and mainly when it includes studies conducted in different stages of the interventional cardiology (period of exclusive use of balloon catheters compared with the subsequent advent of conventional coronary stents and, more recently, drug-eluting stents) and studies using different surgical techniques, considering whether the myocardial revascularization is associated to the cardiopulmonary bypass.

Therefore, this study aimed to assess the incidence of the clinical endpoints (cardiovascular death, symptoms of angina pectoris, rehospitalization for a new acute coronary syndrome (ACS), or the necessity of reintervention during the two-year follow-up) in MCAD patients who were admitted with STEMI and underwent primary PCI for exclusive treatment of the culprit lesion. After their hospital discharge, these patients were initially monitored according to two

aspects: elective approach of residual lesions or optimized clinical treatment.

METHODS

Study population

In total, 143 patients were consecutively admitted to the clinical emergency unit of a tertiary care university hospital in the northwestern region of Sao Paulo State, Brazil, from January 2009 to December 2010. These patients presented a definitive diagnosis of STEMI that included the clinical presentation of chest pain or an equivalent ischemic event compatible with the ACS occurring within 12 hours of the onset of symptoms and a 12-lead electrocardiogram evidencing ST-segment elevation ≥ 2 mm in men and ≥ 1.5 mm in women in at least two precordial leads or ≥ 1 mm in at least two continuous peripheral leads, or a new or presumed-new bundle branch block^[3]. Of these patients, 139 (97.2%) were referred for primary PCI, and four (2.8%) underwent intravenous fibrinolytic therapy with streptokinase. Coronary angiography demonstrated MCAD (defined by visual assessment as a $\geq 70\%$ diameter stenosis of three or more epicardial coronary arteries or their major branches) in 63 patients (45.3%) who were referred to the hemodynamic laboratory (including the culprit artery in the ischemic event and excluding cases with a $\geq 50\%$ obstructive lesion in the left coronary artery). However, this analysis considered 57 individuals after excluding six patients who died during the hospitalization from causes related to the index ischemic event (four deaths due to septic shock and two deaths due to cardiogenic shock).

To establish a comparison between the pre-specified clinical endpoints, this sample was divided into two groups according to the strategy initially adopted by the team of assistant cardiologists regarding the monitoring of MCAD in the following individuals: a Clinical Group (CG) that comprised patients who were discharged from the hospital to have the MCAD monitored in an outpatient clinic under a "conservative" medical therapy (optimized pharmacological therapy associated with counseling for a healthy diet and cardiac rehabilitation) and an Intervention Group (IG) that included individuals who underwent the staged PCI or elective surgical myocardial revascularization approximately one month after the primary PCI with a bare metal stent implantation that was performed on the occasion of the STEMI. This study did not aim to assess the clinical endpoints separately in specific subgroups of patients considering the comorbidities, personal history, or clinical severity of the presentation of the qualifying ischemic event.

Pharmacological therapy

A careful review of the medical records confirmed the administration of dual antiplatelet therapy (including the oral

administration of 200 mg macerated acetylsalicylic acid and the oral administration of 600 mg clopidogrel bisulfate or 300 mg clopidogrel bisulfate for patients aged >75 years), as predicted in the current recommendations^[1-3,18-20] for all 57 patients included in this analysis when they were admitted to the emergency care sector of this hospital unit and prior to the coronary angiography procedure.

Moreover, during the hospitalization period, these patients received optimized pharmacological therapy considering the drugs that are standardized in the Brazilian public health service. In this case, the treatment included the dual antiplatelet therapy (acetylsalicylic acid and clopidogrel bisulfate) recommended for the maintenance phase after the PCI in addition to the administration of an angiotensin-converting enzyme inhibitor or angiotensin II AT1 receptor blocker, beta-blockers, and statins. The prescription given to the patients at the time of hospital discharge also encouraged them to maintain the use of these drugs during the outpatient follow-up. In this case, the optimized pharmacological therapy was considered by the assistant medical team to be the prescription of the target dose or maximum tolerated daily dose of beta-blockers and angiotensin-converting enzyme inhibitor/angiotensin II AT1 receptor blocker for all patients assessed in this study if no contra-indication for these drugs were present. Regarding statins, the patients initially received 80 mg/day atorvastatin between the first and fourth day of STEMI. This dosage was subsequently re-assessed in an outpatient clinic to maintain the therapeutic targets for a serum level of low-density lipoprotein cholesterol fraction. These procedures were followed during all outpatient follow-ups according to the recommendations of the current national guidelines^[1,21,22].

Invasive procedure and outpatient follow-up

The angiography study considered the same arterial puncture sites for both procedures (angiography and coronary angioplasty). Procedures such as aspiration thrombectomy during PCI and the intravenous administration of glycoprotein IIb/IIIa inhibitors were decided exclusively by the assistant hemodynamicist. In the primary PCI scenario, the subgroup of patients with type 2 diabetes mellitus did not receive any different procedures with respect to the percutaneous technique or choice of implanted coronary stent. In this case, the only difference consisted in the outpatient follow-up with the endocrinology team of this service, aiming for adequate glycemic control and the secondary prevention of vascular complications in these patients.

All patients included in this study were monitored in the outpatient cardiology service of this institution, considering the clinical evolution after PCI and the manifestation of symptoms including angina pectoris or an equivalent ischemic event, in addition to using myocardial scintigraphy to detect ischemia caused by residual coronary artery disease associated with physical or pharmacological stress.

Data collection

After project approval by the local Research Ethics Committee (Certificate of Presentation for Ethical Consideration [Certificado de Apresentação para Apreciação Ética - CAAE] number 12662313.3.0000.5415) according to the Declaration of Helsinki, the demographic information of patients eligible for this analysis and the data regarding their hospital evolution were obtained from an extensive review of the medical records of individuals who were admitted with STEMI and underwent invasive coronary stratification in the hemodynamics service of this institution during the analyzed period. The telephone number to contact all patients who were included in this study was obtained at the end of the two-year follow-up after the PCI, and all the follow-up outpatient appointments were carefully reviewed to confirm the clinical endpoints of interest.

Statistical analysis

Data were entered into an Excel® (Microsoft Corp., Redmond, USA) spreadsheet and analyzed with the StatsDirect statistical software version 2.7.8 (11/08/2011). Categorical variables were described as a frequency and percentage and were analyzed with the Fisher exact test. Quantitative variables that presented a Gaussian distribution were compared with an unpaired *t*-test. For variables without a normal distribution, the Mann-Whitney test was used. An α error of 5% was assumed, and $P \leq 0.05$ was considered significant.

RESULTS

The baseline clinical characteristics of patients who were admitted to this service with definitive criteria for STEMI and who underwent primary angioplasty were similar between the IG and the CG ($P > 0.05$ for all variables; Table 1), including the risk factors for coronary artery disease (CAD) and the Killip-Kimball classification.

In this sample, the IG consisted of 13 patients who underwent emergency treatment only on the culprit lesion associated with the STEMI, followed by hospital discharge with scheduling for elective procedures on the residual coronary lesions. In this context, 11 of these patients underwent staged angioplasty of the remaining lesions approximately six weeks after the index ischemic event (procedures performed without description of any complications, including the absence of periprocedural reinfarction, in which there was primary angiographic success – the establishment of TIMI-3 flow and less than 30% residual stenosis – in all patients). The other two patients underwent coronary artery bypass grafting using cardiopulmonary bypass approximately 37 days after STEMI, including an initial month of treatment with dual antiplatelet therapy (acetylsalicylic acid and clopidogrel bisulfate), and one week after discontinuing the daily use of thienopyridine derivative. In addition, the CG included 44 patients who had follow-up outpatient appointments in the cardiology service under a “conservative” strategy.

The radial access was used in 85.9% of patients who underwent coronary angiography. The median door-to-balloon time in this sample was 81 minutes, ranging from 32 to 187 minutes. MCAD was characterized in our study population, with a mean of 3.6 significant coronary lesions per patient. The primary angioplasty included conventional coronary stent implantation (bare metal) in 100% of our sample, resulting in primary angiographic success (reestablishment of TIMI-3 flow after PCI) in 82.4% of the individuals. Table 2 presents additional information about the invasive procedures, including culprit coronary lesions associated with the STEMI and treated during the PCI, in addition to the data regarding residual lesions in both assessed groups. In this case, the higher percentage of ramus diagonalis as the residual lesion in the IG (8.7%) compared with the CG (0%; $P = 0.023$) is highlighted as the only statistically significant difference between the groups.

Table 1. Baseline clinical characteristics of patients admitted with STEMI and who underwent primary PCI.

Variable	Intervention Group (N=13) Median (Min - Max) or n (%)	Clinical Group (N=44) Median (Min - Max) or n (%)	P Value*
Age (years)	62 (51 – 81)	65 (44 – 84)	0.655
Male	9 (69.2)	33 (75.0)	0.681
Type 2 Diabetes Mellitus	7 (53.8)	23 (52.2)	0.927
Dyslipidemia	7 (53.8)	24 (54.5)	0.962
Systemic Arterial Hypertension	9 (69.3)	34 (77.2)	0.566
Tobacco Smoking	6 (46.1)	20 (45.4)	0.962
FH-positive for Premature CAD	4 (30.7)	10 (22.7)	0.566
Sedentarism	9 (69.2)	30 (68.1)	0.962
Overweight/Obesity	9 (69.2)	25 (56.8)	0.450
Killip Class I at Admission	10 (76.9)	35 (79.5)	1.000

STEMI= ST-segment elevation in acute myocardial infarction; PCI= percutaneous coronary intervention; N= number of individuals; n= number of events; Min= minimum value; Max= maximum value; FH= family history; CAD= coronary artery disease; * Fisher's exact test

Table 2. Angiographic data from patients admitted with STEMI and undergoing primary PCI with bare metal stent implantation.

Variables	Intervention Group (N=13) Median (Min - Max) or n (%)	Clinical Group (N=44) Median (Min - Max) or n (%)	P Value *
Information Regarding the Procedures			
Radial Access	11 (84.6)	38 (86.4)	1.000
Door-to-balloon Time for the PCI (min)	84 (46 - 187)	81 (32 - 172)	0.697
Use of a GP IIb/IIIa Inhibitor	1 (7.7)	5 (11.4)	1.000
Aspiration Thrombectomy During the PCI	3 (23)	9 (20.5)	1.000
TIMI-3 Flow after the PCI	10 (76.9)	37 (84.1)	0.680
LVEF \geq 50% on Ventriculography	10 (77.0)	34 (73.3)	0.956
Culprit Lesions Approached During the PCI			
Anterior Descending Artery	6 (46.1)	18 (40.9)	0.759
Diagonal Branch	0 (0)	1 (2.3)	1.000
Circumflex Artery	1 (7.8)	4 (9.0)	1.000
Right Coronary Artery	6 (46.1)	20 (45.5)	1.000
Posterior Descending Branch	0 (0)	1 (2.3)	1.000
Residual Lesions After the PCI			
Anterior Descending Artery	4 (17.5)	23 (18.6)	1.000
Diagonal Branch	3 (13.0)	22 (17.7)	0.766
Ramus Diagonalis	2 (8.7)	0 (0)	0.023
Circumflex Artery	5 (21.7)	27 (21.8)	1.000
Marginal Branch	3 (13.0)	23 (18.6)	0.766
Right Coronary Artery	4 (17.5)	19 (15.3)	0.760
Posterior Descending Branch	1 (4.3)	2 (1.6)	0.402
Posterior Ventricular Branch	1 (4.3)	8 (6.4)	1.000

STEMI= ST-segment elevation in acute myocardial infarction; PCI= percutaneous coronary intervention; N= number of individuals; n= number of events; Min= minimum value; Max= maximum value; min= minutes; GP= glycoprotein; LVEF= left ventricular ejection fraction; *Fisher's exact test

Table 3. Clinical endpoints in the 2-year follow-up of patients who underwent primary PCI only in the culprit lesion associated with the STEMI.

Clinical Endpoints	Intervention Group ^(a)	Clinical Group ^(b)	Clinical Group Scintigraphy with Detection of Ischemia ^(c) (N=24)	P Value * (axb)	P Value * (axc)
	(N=13) n (%)	(N=44) n (%)	n (%)		
Cardiovascular Death	0 (0)	4 (9.1)	4 (16.7)	0.344	0.160
Angina Pectoris	2 (15.4)	23 (52.3)	23 (95.8)	0.020	<0.001
Rehospitalization for an ACS	1 (7.7)	16 (36.4)	16 (66.7)	0.049	0.001
Necessity for Reintervention	1 (7.7)	15 (34.1)	15 (62.5)	0.066	0.001

PCI= percutaneous coronary intervention; STEMI= ST-segment elevation in acute myocardial infarction; N= number of individuals; n= number of events; ACS= acute coronary syndrome; * Fisher's exact test

Myocardial scintigraphic examinations performed in the outpatient clinic approximately six months after the PCI detected the presence of ischemia with a moderate-to-large extension into territories compatible with the residual coronary lesions in 54.5% of the CG patients. By contrast, the IG had only one case of ischemia evidenced by myocardial scintigraphy, which occurred in a patient who had symptoms of angina pectoris after the staged angioplasty. Subsequently, this patient was diagnosed with in-stent restenosis at the culprit lesion associated with STEMI and then underwent zotarolimus-eluting

coronary stent implantation (Endeavor[®]) with angiographic success, progressing without any signs or symptoms indicative of residual ischemia.

Regarding the assessed clinical endpoints, there were no differences between the IG and the CG with respect to the cardiovascular death rate ($P>0.05$) in the two-year follow-up after performing the primary PCI, regardless of the presence of myocardial ischemia evidenced in an outpatient clinic by a non-invasive stratification method (Table 3) and the presence of consequent left ventricular systolic dysfunction observed

during the angiography coronary performed for qualifying ischemic events (data not shown). Although without a significant difference ($P=0.269$), in this case, the Kaplan-Meier analysis demonstrated a marked decrease in the death-free survival rate for the CG within the first six months of follow-up (Figure 1).

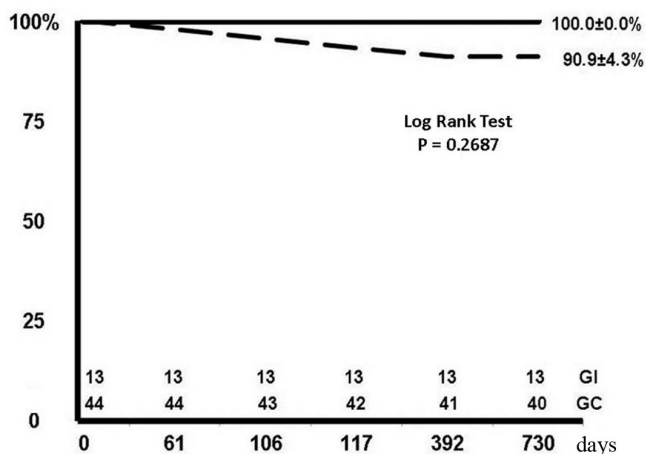


Fig. 1 - Kaplan-Meier actuarial death-free survival curve in the patients from the Intervention Group (continuous line; IG) versus patients from the Clinical Group (dashed line; CG) after primary percutaneous coronary intervention

In addition, the symptom of angina pectoris was evident in more than 50% of individuals from the CG ($P=0.020$), representing almost all patients with evidence of ischemia by the myocardial scintigraphy (95.8% of individuals; $P<0.001$), compared with the IG (15.4%). Nonetheless, in this context, the rehospitalization rate for a new episode of ACS was significantly higher in the CG (36.4%; $P=0.049$), especially among those patients with positive myocardial scintigraphy results for ischemia (66.7%; $P=0.001$), culminating in an even greater necessity for reintervention ($P=0.001$) in this subgroup of patients compared with the IG (7.7% for both comparisons; Table 3).

DISCUSSION

The findings of the current study demonstrate that in a “real world” clinical scenario including patients with MCAD who were admitted with STEMI and underwent primary PCI for exclusive treatment of the culprit lesion, both strategies initially scheduled for outpatient follow-up (elective angioplasty of residual lesions and clinical treatment) did not differ in the cardiovascular mortality over two years. However, the interventionist strategy program (surgical or percutaneous) is highlighted for reducing symptoms such as angina pectoris and rehospitalization for a new episode of ACS. Furthermore, the myocardial scintigraphy confirms its accuracy for predicting such endpoints and the necessity for reintervention in groups of patients on optimized clinical treatment.

The verification of MCAD in individuals admitted with STEMI implies an increased morbidity and mortality compared to those individuals with a single coronary lesion^[23]. In our sample, such diffuse atherosclerotic involvement was observed in 45.3% of patients who underwent angiography coronary, corroborating national^[14,15] and international data^[6,7] in the literature. In this scenario, in which the current guidelines^[1-3] do not recommend primary PCI in arteries not related to the index ischemic event in the absence of hemodynamic instability – as opposed to results recently published^[24,25] that were performed during a period of great technological advancement in the endovascular area combined with the current therapy with new antiplatelet agents and glycoprotein IIb/IIIa inhibitors – this study is distinguished by its unprecedented comparison of long-term cardiovascular endpoints in “real world” Brazilian individuals who underwent staged angioplasty or a unique clinical treatment.

All patients from the IG were electively treated within a period up to 60 days after hospital discharge, to obtain complete revascularization. In this group, the staged PCI might have been clinically oriented, guided by objective evidence of residual ischemia, or suggested by the interventional cardiologist at the time of initial angiography coronary. To date, only two other analyses were performed in a similar scenario^[12,26], and both revealed a reduction in long-term mortality. In this context, although the cardiovascular death rate is more frequent in the CG than in the IG, our results demonstrated no significant difference in cardiovascular mortality between the groups, as evidenced in other populations^[27,28]. The similar baseline characteristics and variables associated with the invasive procedures between IG and CG, also including the culprit coronary lesions associated with STEMI and addressed in primary PCI are factors that strengthen our findings.

Although diabetic patients generally constitute the preferred indication for coronary artery bypass surgery^[29], we found no trend for adverse clinical endpoints among the IG patients, which consisted of more than 50% of patients with type 2 diabetes mellitus who predominantly underwent PCI with bare metal stent implantation. These findings, which at first appear to disagree with the literature and current recommendations regarding the treatment of diabetic patients with multivessel disease, remind us that the main evidence against the percutaneous coronary angioplasty in diabetic patients originated during the period of exclusive balloon catheter use, i.e., these data originated from occasional results of the BARI (Bypass Angioplasty Revascularization Investigation)^[30-33].

The evolution of patients initially treated in a “conservative” approach demonstrated the significantly higher proportions of endpoints such as angina pectoris and rehospitalization for an ACS when compared to the IG, especially in individuals with ischemia diagnosed by myocardial scintigraphy performed in an outpatient clinic. In this case, the protective effect obtained with the staged revascularization in the IG might occur due

to the most complete treatment of other potentially unstable atherosclerotic plaques^[34,35]. In addition, another reasonable explanation would be the fact that the inflammatory reaction triggered during the ACS process responsible for the plaque instability in STEMI was not limited to the culprit lesion, consequently compromising the entire coronary tree^[23]. Although it did not occur in our sample, Meliga et al.^[36] reported that the complete revascularization of these patients should not be based only on angiographic findings but ideally should be guided by evidence of correlated ischemia, as justified by the high risk of periprocedural ischemic complications.

The increased requirement for other approaches in the CG patients with positive myocardial scintigraphy results for ischemia warns for strict outpatient follow-ups in patients with significant residual CAD, including the consideration of this imaging test as a complementary diagnostic method in selected cases, even in patients under optimized therapy^[10]. In our sample, the high percentage of individuals with angina pectoris symptoms in this subgroup of patients, many of them readmitted for a new episode of ACS during the predetermined follow-up visit, highlights myocardial scintigraphy for the early discriminatory accuracy of individuals potentially vulnerable to the occurrence of major cardiovascular events^[7]. In this context, although there is no general recommendation regarding the ideal period indicated for noninvasive re-stratification of these patients in the current guidelines^[1-3], our results suggest that myocardial scintigraphy may help identify individuals at high risk for new cardiovascular events during the first six months after primary PCI.

Study limitations

This study demonstrates the experience of a single tertiary care university hospital with primary PCI in the STEMI scenario and staged approaches of residual MCAD. Additionally, like any observational study, this analysis is prone to selection bias regarding the choice of the follow-up strategy, including complete revascularization or medical treatment alone. Finally, the small number of subjects in each group might limit the prognostic assessment of the considered patients, in addition to affecting the statistical power of the study and the consequent interpretation of the pre-specified clinical endpoints, thereby preventing the development of definitive conclusions.

CONCLUSION

Our results suggest that the multivessel approach considering the staged PCI appears to be safe and able to reduce angina pectoris and rehospitalization for a new episode of ACS. In addition, it decreases the likelihood of unplanned reintervention in patients without detectable ischemia on the myocardial scintigraphy. Additional investigations including randomized clinical trials are necessary to produce sufficiently robust evidence that will contribute to updating the current

recommendations regarding the MCAD approach in the STEMI scenario.

Authors' roles & responsibilities

JGRP	Design of the project; collecting data; statistical analysis; discussion of results; manuscript writing.
MFG	Statistical analysis; discussion of results
MAS	Collecting data
FCP	Collecting data
AVGO	Collecting data
LFT	Collecting data
DN	Collecting data
MAN	Design of the project; Statistical analysis; discussion of results; manuscript writing

REFERENCES

1. Piegas LS, Feitosa G, Mattos LA, Nicolau JC, Rossi Neto JM, Timerman A, et al. Sociedade Brasileira de Cardiologia. IV Diretriz da Sociedade Brasileira de Cardiologia sobre tratamento do infarto agudo do miocárdio com supradesnível do segmento ST. *Arq Bras Cardiol.* 2009;93:e179-e264.
2. Task Force on the management of ST-segment elevation acute myocardial infarction of the European Society of Cardiology (ESC), Steg PG, James SK, Atar D, Badano LP, Blömstrom-Lundqvist C, Borger MA, et al. ESC Guidelines for the management of acute myocardial infarction in patients presenting with ST-segment elevation. *Eur Heart J.* 2012;33(20):2569-619.
3. American College of Emergency Physicians; Society for Cardiovascular Angiography and Interventions, O'Gara PT, Kushner FG, Ascheim DD, Casey DE Jr, Chung MK, Lemos JA, et al. 2013 ACCF/AHA guideline for the management of ST-elevation myocardial infarction: a report of the American College of Cardiology Foundation/American Heart Association Task Force on Practice Guidelines. *J Am Coll Cardiol.* 2013;61(4):e78-140.
4. Waldecker B, Waas W, Haberbosch W, Voss R, Heizmann H, Tillmanns H, et al. Long-term follow-up after direct percutaneous transluminal coronary angioplasty for acute myocardial infarction. *J Am Coll Cardiol.* 1998;32(5):1320-5.
5. Grines CL, Cox DA, Stone GW, Garcia E, Mattos LA, Giambartolomei A, et al. Coronary angioplasty with or without stent implantation for acute myocardial infarction. Stent Primary Angioplasty in Myocardial Infarction Study Group. *N Engl J Med.* 1999;341(26):1949-56.
6. Moreno R, García E, Soriano J, Abeytua M, López de Sá E, Acosta J, et al. Early coronary angioplasty for acute myocardial infarction: predictors of a poor outcome in a non-selected population. *J Invas Cardiol.* 2001;13(3):202-10.

7. Widimsky P, Holmes DR Jr. How to treat patients with ST-elevation acute myocardial infarction and multivessel disease? *Eur Heart J*. 2011;32(4):396-403.
8. Muller DW, Topol EJ, Ellis SG, Sigmon KN, Lee K, Califf RM, et al. Multivessel coronary artery disease: a key predictor of short-term prognosis after reperfusion therapy for acute myocardial infarction. Thrombolysis and Angioplasty in Myocardial Infarction (TAMI) Study Group. *Am Heart J*. 1991;121(4 Pt 1):1042-9.
9. Jaski BE, Cohen JD, Trausch J, Marsh DG, Bail GR, Overlie PA, et al. Outcome of urgent percutaneous transluminal coronary angioplasty in acute myocardial infarction: comparison of single-vessel versus multivessel coronary artery disease. *Am Heart J*. 1992;124(6):1427-33.
10. Corpus RA, House JA, Marso SP, Grantham JA, Huber KC Jr, Laster SB, et al. Multivessel percutaneous coronary intervention in patients with multivessel disease and acute myocardial infarction. *Am Heart J*. 2004;148(3):493-500.
11. Rigattieri S, Biondi-Zoccai G, Silvestri P, Di Russo C, Musto C, Ferraiuolo G, et al. Management of multivessel coronary disease after ST elevation myocardial infarction treated by primary angioplasty. *J Intervent Cardiol*. 2008;21(1):1-7.
12. Hannan EL, Samadashvili Z, Walford G, Holmes DR Jr, Jacobs AK, Stamato NJ, et al. Culprit vessel percutaneous intervention versus multivessel and staged percutaneous coronary intervention for ST-segment elevation myocardial infarction patients with multivessel disease. *JACC Cardiovasc Interv*. 2010;3(1):22-31.
13. Kornowski R, Mehran R, Dangas G, Nikolsky E, Assali A, Claessen BE, et al; HORIZONS-AMI Trial Investigators. Prognostic impact of staged versus "one-time" multivessel percutaneous intervention in acute myocardial infarction: analysis from the HORIZONS-AMI (harmonizing outcomes with revascularization and stents in acute myocardial infarction) trial. *J Am Coll Cardiol*. 2011;58(7):704-11.
14. Sousa AGMR, Costa Jr. JR, Abizaid A, Buitrón F, Constantini C, Marchant E, et al. Perfil demográfico e resultados imediatos dos pacientes submetidos à angioplastia primária no Registro SOLACI. *Rev Bras Cardiol Invas*. 2009;17(3):335-9.
15. Matte BS, Bergoli LCC, Balvedi JA, Zago AC. Perfil da intervenção coronária percutânea no infarto agudo do miocárdio com supradesnívelamento do segmento ST no Brasil de 2006 a 2010: Registro CENIC. *Rev Bras Cardiol Invas*. 2011;19(2):131-7.
16. Almeida RMS. Is the best option of treatment being offered to patients with multiple coronary artery diseases? *Rev Bras Cir Cardiovasc*. 2006;21(2):III-VI.
17. Andrade PJ, Medeiros MM, Andrade AT, Lima AA. Coronary angioplasty versus CABG: review of randomized trials. *Arq Bras Cardiol*. 2011;97(3):e60-9.
18. Dangas G, Mehran R, Guagliumi G, Caixeta A, Witzensbichler B, Aoki J, et al. Role of clopidogrel loading dose in patients with ST-segment elevation myocardial infarction undergoing primary angioplasty: results from the HORIZONS-AMI (harmonizing outcomes with revascularization and stents in acute myocardial infarction) trial. *J Am Coll Cardiol*. 2009;54(15):1438-46.
19. Mehta SR, Tanguay JF, Eikelboom JW, Jolly SS, Joyner CD, Granger CB, et al; CURRENT-OASIS 7 trial investigators. Double-dose versus standard-dose clopidogrel and high-dose versus low-dose aspirin in individuals undergoing percutaneous coronary intervention for acute coronary syndromes (CURRENT-OASIS 7): a randomised factorial trial. *Lancet*. 2010;376(9748):1233-43.
20. Patrono C, Andreotti F, Arnesen H, Badimon L, Biagent C, Collet JP, et al. Antiplatelet agents for the treatment and prevention of atherothrombosis. *Eur Heart J*. 2011;32(23):2922-32.
21. Sociedade Brasileira de Cardiologia / Sociedade Brasileira de Hipertensão / Sociedade Brasileira de Nefrologia. VI Brazilian guidelines of hypertension. *Arq Bras Cardiol*. 2010;95(1 Suppl 1):1-51.
22. Xavier HT, Izar MC, Faria Neto JR, Assad MH, Rocha VZ, Sposito AC, et al. V diretriz brasileira de dislipidemias e prevenção da aterosclerose. *Arq Bras Cardiol*. 2013;101(4 Suppl 1):1-20.
23. Goldstein JA, Demetriou D, Grines CL, Pica M, Shoukfeh M, O'Neill WW. Multiple complex coronary plaques in patients with acute myocardial infarction. *N Engl J Med*. 2000;343(13):915-22.
24. Qarawani D, Nahir M, Abboud M, Hazanov Y, Hasin Y. Culprit only versus complete coronary revascularization during primary PCI. *Int J Cardiol*. 2008;123(3):288-92.
25. Varani E, Balducci M, Aquilina M, Vecchi G, Hussien MN, Frassinetti V, et al. Single or multivessel percutaneous coronary intervention in ST-elevation myocardial infarction patients. *Catheter Cardiovasc Interv*. 2008;72(7):927-33.
26. Jensen LO, Thayssen P, Farkas DK, Hougaard M, Terkelsen CJ, Tilsted HH, et al. Culprit only or multivessel percutaneous coronary interventions in patients with ST-segment elevation myocardial infarction multivessel disease. *EuroIntervention*. 2012;8(4):456-64.
27. Politi L, Sgura F, Rossi R, Monopoli D, Guerri E, Leuzzi C, et al. A randomised trial of target-vessel versus multi-vessel revascularisation in ST-elevation myocardial infarction: major adverse cardiac events during long-term follow-up. *Heart*. 2010;96(9):662-7.
28. Navarese EP, De Servi S, Buffon A, Suryapranata H, De Luca G. Clinical impact of simultaneous complete revascularization vs. culprit only primary angioplasty in patients with ST-elevation myocardial infarction and multivessel disease: a meta-analysis. *J Thromb Thrombolysis*. 2011;31(2):217-25.
29. Fihn SD, Gardin JM, Abrams J, Berra K, Blankenship JC,

- Dallas AP; et al. 2012 ACCF/AHA/ACP/AATS/PCNA/SCAI/STS Guideline for the diagnosis and management of patients with stable ischemic heart disease: a report of the American College of Cardiology Foundation/American Heart Association Task Force on Practice Guidelines, and the American College of Physicians, American Association for Thoracic Surgery, Preventive Cardiovascular Nurses Association, Society for Cardiovascular Angiography and Interventions, and Society of Thoracic Surgeons. *J Am Coll Cardiol*. 2012;60(24):e44-e164.
30. The Bypass Angioplasty Revascularization Investigation (BARI) Investigators. Comparison of coronary bypass surgery with angioplasty in patients with multivessel disease. *N Engl J Med*. 1996;335(4):217-25.
31. Berger PB, Velianou JL, Aslanidou Vlachos H, Feit F, Jacobs AK, Faxon DP, et al. Survival following coronary angioplasty versus coronary artery bypass surgery in anatomic subsets in which coronary artery bypass surgery improves survival compared with medical therapy. Results from the Bypass Angioplasty Revascularization Investigation (BARI). *J Am Coll Cardiol*. 2001;38(5):1440-9.
32. The Bypass Angioplasty Revascularization Investigation (BARI) Investigators. Influence of diabetes on 5-year mortality and morbidity in a randomized trial comparing CABG and PTCA in patients with multivessel disease: the Bypass Angioplasty Revascularization Investigation (BARI). *Circulation*. 1997;96(6):1761-9.
33. Writing Group for the Bypass Angioplasty Revascularization Investigation (BARI) Investigators. Five-year clinical and functional outcome comparing bypass surgery and angioplasty in patients with multivessel coronary disease. A multicenter randomized trial. *JAMA*. 1997;277(9):715-21.
34. Kalarus Z, Lenarczyk R, Kowalczyk J, Kowalski O, Gasior M, Was T, et al. Importance of complete revascularization in patients with acute myocardial infarction treated with percutaneous coronary intervention. *Am Heart J*. 2007;153(2):304-12.
35. Lisboa LAF, Dallan LAO, Puig LB, Abreu Filho C, Leca RC, Dallan LAP, et al. Midterm follow-up with exclusive use of arterial grafts in complete myocardial revascularization of patients with triple vessel coronary artery disease. *Rev Bras Cir Cardiovasc*. 2004;19(1):9-16.
36. Meliga E, Fiorina C, Valgimigli M, Belli R, Gagnor A, Sheiban I, et al. Early angio-guided complete revascularization versus culprit vessel PCI followed by ischemia-guided staged PCI in STEMI patients with multivessel disease. *J Interv Cardiol*. 2011;24(6):535-41.