

## ORIGINAL ARTICLE

## Clinical Outcomes of Percutaneous Intervention in Triple-Vessel and Left Main Coronary Artery Diseases

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### Abstract

**Background:** Myocardial revascularization in triple-vessel and left main coronary artery (LMCA) diseases can be performed by percutaneous coronary intervention (PCI) or coronary artery bypass grafting (CABG). The SYNTAX trial demonstrated equivalent clinical results in patients with low to moderate anatomical complexity undergoing CABG or PCI.

**Objectives:** To evaluate the incidence of cardiovascular events and rates of new myocardial revascularization in patients with LMCA and triple-vessel lesions undergoing PCI.

**Methods:** Nonrandomized, observational cohort study that evaluated patients with triple-vessel or LMCA diseases undergoing PCI with drug-eluting stent in the period from June 2013 to May 2015 at the *Hospital SOS Cardio* in Florianópolis. Baseline data, main anatomical features, and clinical outcomes were reported during the in-hospital phase and during a 12-month follow-up.

**Results:** In total, 46 patients with a mean age of 69.9 years were evaluated. At baseline, 39.1% had diabetes mellitus, 19.6% were smokers, 78.3% had dyslipidemia, 10.9% had chronic renal dysfunction, and 15.2% had moderate to severe ventricular dysfunction. As regards the number of arteries affected, 24% had triple-vessel disease and 76% had lesions in the LMCA. During the in-hospital period, there was a 4.34% rate of acute myocardial infarction without ST elevation. During this period, reintervention was not required and no deaths occurred. In the 12-month follow-up, mortality from cardiovascular causes was 4.35%. The rate of new revascularization was 4.3% by CABG and 2.2% by angioplasty.

**Conclusion:** The rates of cardiovascular events were low, indicating that PCI may be an acceptable alternative in selected cases. (*Int J Cardiovasc Sci.* 2016;29(4):262-269)

**Keywords:** Myocardial Revascularization; Percutaneous Coronary Intervention; Coronary Disease; Cardiac Catheterization.

### Introduction

Coronary artery disease (CAD) remains one of the most important diseases because of its high morbidity and mortality.<sup>1</sup> However, preventive measures such as lifestyle changes, modification of risk factors, improvements in medical therapy, and advances in coronary artery bypass grafting (CABG) and percutaneous coronary intervention (PCI) have resulted

in a reduction in mortality related to cardiovascular diseases.<sup>2</sup>

The optimal revascularization strategy in patients with CAD remains a subject of debate among interventional cardiologists and surgeons. The main objective of CABG is the improvement of symptoms, quality of life, exercise capacity, and prognosis.<sup>3-6</sup> Myocardial revascularization should be considered in patients with evidence of

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moderate to severe ischemia, which in turn is associated with an annual rate of 4–6% of risk of cardiovascular death or nonfatal acute myocardial infarction, as well as the development of heart failure, sudden cardiac death, or arrhythmias.<sup>7,8</sup>

PCI was first introduced in 1977. Since then, its use has increased in recent decades in the various manifestations of CAD.<sup>9,10</sup>

Several studies have compared the revascularization strategy by PCI or CABG in patients with triple-vessel CAD and/or lesion in the left main coronary artery (LMCA).<sup>10-14</sup> Regardless of being carried out by PCI or CABG, evidence supports the role of complete revascularization by both techniques.<sup>15-17</sup>

The SYNTAX study showed, in this group of patients, that PCI treatment with a drug-eluting stent (DES) was associated with mortality equivalent to treatment with CABG, despite a greater risk of a repeat bypass, but with a reduced risk of stroke.<sup>10</sup>

The success of complete revascularization by PCI is often hampered by the presentation of the disease with a complex coronary anatomy, chronic occlusions, plus additional risks such as age, renal failure, and extracardiac arteriopathy. However, many of these patients are also not able to undergo CABG; for them, treatment by PCI is the only option for revascularization, despite a high SYNTAX score.<sup>10,18-20</sup>

The aim of this study was to evaluate the safety of PCI with DES in patients with triple-vessel CAD and/or lesion in the LMCA in a hospital environment and their clinical outcomes during a 1-year period.

## Methodology

Observational, nonrandomized, cohort study conducted at the Hemodynamic and Interventional Cardiology Department of the *Hospital SOS Cardio* in Florianópolis, Santa Catarina.

The patients were selected from the hemodynamic department's database. Initially, 86 patients were included from both sexes, any age range, with triple-vessel CAD and/or LMCA lesion, undergoing PCI in the period from June 2013 to May 2015. The decision to perform PCI was considered when the patient had a favorable anatomy and refused surgery, or when he or she had a high risk of surgical mortality, assessed by the EuroSCORE.<sup>21</sup> Patients with previous treatment by CABG

or those who missed out on the clinical follow-up were excluded, resulting in a total of 46 cases.

All procedures were performed by the same interventional cardiologist at the institution. Latest generation DESs (PROMUS, XIENCE, Resolute Integrity, Nobori) were used, chosen at the time of the procedure according to the coronary anatomy. Intracoronary ultrasound was used in cases where a better definition of the atheromatous plaque characteristics was deemed necessary, in order to provide a better result.

Data collection was performed using electronic medical records from the TASY system and printed medical records. The researcher contacted all patients by phone within a minimum period of 1 year after the procedure. The interview was conducted with the patient or a family member in charge of the patient using a spreadsheet containing the variables. For analysis of clinical outcomes, questions were asked in the interview about symptoms and complications during the period after the procedure. If there were reports of new angioplasty, CABG, or death, the data were recorded in the records of the aforementioned hospital or by a medical assistant, with a prior consent by the patient. All deaths were considered of cardiac origin unless a noncardiac cause was clearly identified.

The diagnosis of myocardial infarction was defined according to the universal definition of myocardial infarction.<sup>22</sup> The left ventricular systolic function was classified as normal, when the ejection fraction was above 55%; mild dysfunction, when between 45 and 54%; moderate dysfunction, when between 30 and 44%; and significant dysfunction, when < 30%. The PCI success was determined by a TIMI-3 flow and a residual stenosis lower than 30% by visual assessment.

The data were analyzed by the SPSS 22.0 program. The statistical analysis began with the description of the study variables. Association tests between the dependent and independent variables were carried out using Fisher's exact test, with statistical significance at  $p < 0.05$ .

As this study involved data collected from the patients' medical records, due to the difficulty of obtaining individual consent, the researchers committed to respecting the confidentiality of the data and preserving anonymity. The *Hospital SOS Cardio* authorized the collection of data from medical records, and the project was approved by the Research Ethics Committee under the number 50334715.7.0000.0113.

## Results

A total of 46 patients aged 48 to 92 years (mean 69.9 years) were studied.

The following clinical features were verified in the study patients: diabetes mellitus in treatment (n = 18; 39.1%), active smoking habit (n = 9; 19.6%), dyslipidemia (n = 36; 78.3%), chronic renal failure (n = 5; 10.9%), and moderate to severe ventricular dysfunction (n = 7; 15.2%).

For the clinical presentation, patients were stratified into symptomatic and asymptomatic. The symptomatic

patients had stable angina (n = 12; 26.1%), unstable angina (n = 13; 28.3%), ST-elevation myocardial infarction (STEMI; n = 8; 17.4%), non-ST-elevation myocardial infarction (NSTEMI; n = 2, 4.3%) and left ventricular heart failure (n = 8; 17.4%). Eight patients were asymptomatic (17.4%).

For analysis purposes as well, patients were stratified as regards the number of affected arteries: triple-vessel (without LMCA lesion; n = 11; 23.9%), ostial/body LMCA lesion (excluding bifurcation; n = 7; 15.2%), and LMCA bifurcation lesion (n = 28; 60.8%) (Table 1).

**Table 1**  
Characteristics of the study population (n = 46)

Variables	Prevalence (n)	(%)
Age > 65 years	31	67.4
Male gender	28	60.9
Hypertension	40	87
Current smoking	9	19.6
Dyslipidemia	36	78.3
Diabetes in treatment	18	39.1
Prior angioplasty	16	34.8
Moderate/severe ventricular dysfunction	7	15.2
Chronic renal disease	5	10.9
Asymptomatic	8	17.4
Stable angina	12	26.1
Unstable angina	13	28.3
NSTEMI	8	17.4
STEMI	2	4.3
LVHF	8	17.4
Triple-vessel (no LMCA lesion)	11	24
Ostial/body LMCA lesion (no bifurcation)	7	15.2
LMCA lesion (bifurcation)	28	60.8

STEMI: ST-elevation myocardial infarction; LMCA: left main coronary artery; LVHF: left ventricular heart failure; NSTEMI: non-ST-elevation myocardial infarction.

The success rate of the procedures was 100%. LMCA angioplasties were performed with only one stent in 29 cases (63%), LMCA angioplasties with more than one stent in six cases (13%), and triple-vessel angioplasty without LMCA lesion in 11 cases (23.9%). There were no deaths or emergency CABG in the procedures (Table 2).

During the in-hospital period, there were two cases (4.34%) of NSTEMI. In one of the cases, there was a distal branch occlusion of the first marginal. In the second case, there was an occlusion of a sub-branch of the diagonal artery. None of the cases required a new reintervention by PCI or CABG. There were no deaths during this phase (Table 3).

At hospital discharge, all patients received dual antiplatelet therapy, with 46 (100%) cases receiving aspirin. In association with aspirin, 25 (54.3%) received ticagrelor, 18 (39.1%) received clopidogrel, and three (6.5%) were discharged with prasugrel (Table 4).

In the follow-up after hospital discharge, the outcomes were classified in the period between 0 and 6 months, and between 6 and 12 months. Among the patients, five (10.86%) had the outcome documented during follow-up. There was one death (2.2%) and one case of angioplasty (2.2%) in the first 6 months of monitoring after the procedure. In the period from 6 to 12 months, there were three deaths (6.5%), two cases of CABG (4.3%), and one case of angioplasty (2.2%) (Table 5).

**Table 2**  
**Procedure results**

Variables	Prevalence (n)	(%)
Success of the procedures	46	100
LMCA angioplasty with 1 stent	29	63
LMCA angioplasty with > 1 stent	6	13
Triple-vessel angioplasty without LMCA lesion	11	24
Death	0	0
Emergency CABG	0	0

LMCA: left main coronary artery; CABG: coronary artery bypass grafting.

**Table 3**  
**In-hospital outcome**

Variables	Prevalence (n)	(%)
Death	0	0
AMI	2	4.34
CABG	0	0
New angioplasty	0	0

AMI: acute myocardial infarction; CABG: coronary artery bypass grafting.

**Table 4**  
**Antiplatelet therapy**

Variables	Prevalence (n)	(%)
Aspirin	46	100
Ticagrelor	25	54.3
Clopidogrel	18	39.1
Prasugrel	3	6.5

**Table 5**  
**Follow-up after angioplasty**

Variables	6 months	6 to 12 months	Total
	Prevalence (%)	Prevalence (%)	Prevalence (%)
Total mortality	1 (2.2)	3 (6.5)	4 (8.7)
Cardiovascular mortality	0	2 (4.34)	2 (4.34)
CABG	0	1 (2.2)	1 (2.2)
Angioplasty	1 (2.2)	1 (2.2)	2 (4.4)

*CABG: coronary artery bypass grafting.*

The overall mortality in the study was 8.7% (n = 4), and in two cases (4.35%), the deaths were due to cardiovascular causes. The two cases of noncardiovascular death occurred from complications with an infectious cause. In relation to deaths with a cardiovascular cause, one was a sudden

death at home, and the other was due to myocardial infarction. Among the deaths, the mean age was 82 years. The mortality rate as a risk factor was significantly associated with left ventricular heart failure and with moderate to severe ventricular dysfunction (Table6).

**Table 6**  
**Characteristics relevant to mortality**

Variables	Total mortality		p*
	No n(%)	Yes n(%)	
Ventricular dysfunction Yes No	4(57.14) 38(99.43)	3(42.85) 1(2.56)	0.009
LVHF Yes No	4(50) 38(100)	4(50) 0(0)	0.000

*\*LVHF: left ventricular heart failure.*

## Discussion

Regarding the clinical characteristics of the study patients, the data found were similar to those from other studies in patients with triple-vessel disease or LMCA associated with hypertension, dyslipidemia, smoking, and prior angioplasty.<sup>10,23-28</sup> It is noteworthy that the prevalence of diabetes mellitus, which was 39.1% in the population studied, is among the highest levels when compared with other studies.<sup>10,23-28</sup> Chronic kidney disease, whose patients are included in just a few studies because of the severity of this condition, showed a high prevalence (10.9%) in the present population, higher levels than most other studies that include this kind of patient.<sup>10,23-28</sup> In spite of the small sample size, this is indicative that the population presented in this study had a high cardiovascular risk when compared with those of other randomized studies.

During the in-hospital phase, the rate of acute myocardial infarction was low (4.34%), and the episodes that occurred were related to arteries of little relevance and with no clinical significance, similar to that described in the literature.<sup>10,29,30</sup> There were no deaths during the in-hospital period, which was lower than that found in the meta-analysis of Biondi-Zoccai et al.,<sup>31</sup> in which 16 studies were evaluated with a total of 1,278 patients with a mortality of 1.7% in 30 days.

During the 12-month follow-up after the angioplasty, the death rate from any cause in our study (8.7%) was similar to that in other studies<sup>29,30</sup> and slightly higher than that of the SYNTAX study (4.4%). We attribute the cases of death in the study to an elevated age range and high cardiovascular risk.

Regarding the immediate complications and patient follow-up, an acceptable rate of repeat revascularization was found, with 6.6% of cases, which was less than the SYNTAX study, with 13.5% in the PCI group. In the present study, the repeat revascularization was performed more frequently by PCI (4.4%) than by CABG (2.2%), which was similar to the SYNTAX study, with 2.8% by CABG and 11.4% by PCI.

We consider the follow-up period satisfactory in relation to PCI and cardiovascular events, whereas, usually, with a longer follow-up of up to 5 years, the number of events and their incidence are likely to remain similar to intermediate follow-up values.<sup>32</sup>

This low number of cardiovascular events can still be explained by the better socioeconomic and knowledge

status of the patients because the study was conducted in a private center, in which patients were frequently monitored by their clinical cardiologists and had their medication maintained at optimal levels.

## Study limitations

The main limitation of the study is the size of the population included. One should also mention the fact that it was a single-arm, observational, and nonrandomized register.

## Conclusion

We conclude from this study that treatment by PCI with DES in LMCA and triple-vessel atherosclerotic disease in clinical practice is safe and effective both in the hospital phase and in the long term, with low rates of cardiac death and stent thrombosis. This indicates that this strategy is an acceptable alternative, or possibly even preferred in selected cases.

## Author contributions

Conception and design of the research: Cunha SC. Acquisition of data: Cunha SC, São Thiago LEK, Sartor EM. Analysis and interpretation of the data: Cunha SC, São Thiago LEK, Sartor EM. Statistical analysis: Cunha SC, Sartor EM. Writing of the manuscript: Cunha SC, São Thiago LEK, Sartor EM. Critical revision of the manuscript for intellectual content: Cunha SC, São Thiago LEK, Sartor EM.

## Potential Conflict of Interest

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

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## Study Association

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