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CASE REPORT

# PERCUTANEOUS CORONARY INTERVENTION IN CHRONIC TOTAL OCCLUSION (CTO): CASE REPORT OF HIGH-RISK CORONARY INTERVENTION

DÉBORA FREIRE RIBEIRO ROCHA[1,2] , HENRIQUE LIMA GUIMARÃES[1], MAURÍCIO PRUDENTE LOPES[1], FLAVIO PASSOS BARBOSA[1], ÁLVARO DE MORAIS JÚNIOR[1], GIULLIANO GARDENGHI[1]

**ABSTRACT**

High-risk percutaneous coronary intervention (CHIP-PCI) refers to targeted percutaneous revascularization for patients with extensive coronary artery disease (CAD). It requires a skill set, personnel, equipment and logistical support beyond fabrication for conventional PCI. PCI in chronic total occlusion (CTO) is an expanding field of interventional cardiology. Despite this, an ICP-CTO corresponds to only 10% of the total number of procedures. The guidelines recommend that current CTO PCI should be considered for reduction of blood in the corresponding myocardial territory and/or for reduction of angina. In this paper, we describe a case of a CHIP-PCI in a symptomatic coronary artery disease patient with the protective device in case of comorbidities and high PC at surgical risk.

**KEYWORDS: CORONARY ARTERY DISEASE / COMPLICATIONS; CORONARY OCCLUSION; PERCUTANEOUS CORONARY INTERVENTION**

## INTRODUCTION

An increasing number of patients with coronary artery disease (CAD) require complex and clinically indicated percutaneous coronary interventions (CHIP-PCI). Advanced age, multiple comorbidities and some anatomical circumstances such as disease of the left trunk and/or bifurcation, long and calcified lesions and chronic total occlusions are factors that can lead a patient to be considered a candidate for CHIP-PCI [1].

High-risk CHIP-PCI refers to clinically guided percutaneous revascularization of patients with extensive coronary artery disease (CAD). It requires a set of skills, personnel, equipment and logistical support in addition to those needed for regular PCI. The CHIP concept was highlighted in a 2016 position paper. CHIP assignment was based on demographic factors (age), comorbidities (advanced kidney disease, previous coronary artery bypass graft surgery, heart failure), or anatomical and procedurals ( extension of CAD, treatment of the left main trunk or chronic total occlusion injuries, use of mechanical cardiac support or use of atherectomy devices). However, the clear definition for CHIP has not been agreed and data on the outcome of CHIP in relation to PCI or more usual conventional bypass surgery are lacking [2].

All proposed risk definitions for revascularization procedures incorporate specific characteristics from three spheres: patient risk factors and comorbidities (including those that preclude surgical or percutaneous revascularization); location and complexity of coronary arteries anatomy (including suitability of vessels for PCI or for surgical targets); and hemodynamics, ventricular function and concomitant valve disease. It is the composite risk derived from the integration of each of these three areas that leads to the cumulative process of the individual risk profile of any CAD patient for whom revascularization is considered [3].

PCI in patients with factors such as left ventricular systolic failure (function defined as ejection fraction <35%), unprotected left trunk disease, severe three-vessel disease (SYNTAX score >33), or last patent vessel is associated with in-hospital mortality higher rates between 5% and 15% [2,3].

Chronic total occlusions, often called CTO in Brazil, are defined as coronary obstructions that produce total occlusion of the vessel lumen with a TIMI 0 flow and a duration of more than three months. They are present in 18-52% of patients undergoing coronary angiography and who have coronary artery disease4. However, PCI for CTO treatment corresponds to only 10% of all procedures, and remains one of the most challenging interventions in the specialty[5].

Current guidelines recommend that CTO PCI should be considered to reduce ischemia in the corresponding

1. Hospital ENCORE
2. Universidade Federal de Goiás

**ADDRESS**
GIULLIANO GARDENGHI
Rua Gurupi, Quadra 25, Lote 6 a 8, Vila Brasília,
Aparecida de Goiânia, Goiás, 74905-350
E-mail: ggardenghi@encore.com.br

myocardial territory and/or to reduce angina. Thus, CTO revascularization will be indicated when there is objective evidence of viability, ischemia of a sufficiently large territory and/or symptoms of angina[4].

Currently, PCI is an excellent option in the management of CTO, but the correct selection of patients, a careful evaluation of the anatomical aspects of the lesion, the availability of devices dedicated to the management of occlusions (laser and materials - microcatheter, polymeric guide low weight), availability of drug-eluting stents and training of specialized operators [7,8,9].

In patients with clinical indication for CTO revascularization, careful evaluation of coronary angiography is essential to ensure the success of the procedure and define the appropriate strategy. In addition, the use of angiographic scores, such as J-CTO, PROGRESS-CTO, CL, ORA and EUROCTO, can help to establish the degree of difficulty of the procedure and the probability of success, allowing to guide clinical decision-making, as well as the best choice of cases according to operator experience [11].

The decision to attempt CTO-PCI should be weighed against the risk of higher volume of contrast, longer fluoroscopy time, and higher rates of major cardiovascular events (MACE) compared with non-CTO-PCI 4 patients.

Although the number of randomized and controlled studies is still limited, results from large multicenter registries allow us to safely offer this intervention to patients, as another treatment option along with optimized drug treatment and coronary artery bypass graft surgery [4,7].

Current CTO-PCI data show a continuous increase in procedure success rates in experienced centers, reaching a 90% success rate in high volume and experience centers. As well as low MACE rates, below 2%[10,12].

Thus, this study aims to report a case of high-risk PCI for CTO treatment in a symptomatic coronary artery disease patient with multiple comorbidities.

The Research Ethics Committee of the Hospital de Urgências de Goiânia, linked to Plataforma Brasil, approved the present study (CAAE: 53038921.2.0000.0033).

## CASE REPORT

A 52-year-old male hypertensive, insulin-dependent, dyslipidemic, obese (BMI 44.1 kg/m2) and coronary artery disease patient in outpatient follow-up with a cardiologist reports dyspnea and fatigue for 2 years.

He was previously submitted to coronary artery bypass graft surgery in 2009 due to three-vessel coronary artery disease with a high SYNTAX score (42.5), with implantation of three bypasses, as described below: left internal thoracic artery (LITA)-DA, saphenous vein-CD and saphenous vein-CX.

To investigate the clinical picture, a myocardial perfusion scintigraphy was initially requested on 01/29/2021, which showed 22% of perfusion defects, 15% of which were persistent in the inferior and inferolateral walls, with an ischemic load of 7% and left ventricular ejection fraction (LVEF) of 38% at rest and 35% at stress.

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The case was discussed with the institution's heart team, with reoperation for coronary artery bypass grafting contraindicated, when a complex angioplasty was performed, as it is a symptomatic patient (CCS class III), diabetic, with very high cardiovascular risk. and high surgical risk (STS score of 5.927% and Euroscore-II of 8.53% for mortality risk).

In the pre-intervention planning, a transthoracic echocardiogram (TT Echo) and a coronary tomography angiography were requested to assess segmental alteration in ventricular contractility and left ventricular ejection fraction (LVEF), as well as to know the coronary anatomy of the patient.

The TT ECHO performed on 04/22/2021 showed moderate impairment of left ventricular systolic function (LVEF 40%), diffuse LV hypokinesia, moderate LV diastolic dysfunction, tricuspid regurgitation (PSVD 49 mmHg vel peak 3.1 m/s ).

The coronary CT angiography of 04/22/2021 revealed three-vessel atherosclerotic disease with proximal occlusions in the DA, circumflex (CX) and right (RC) arteries (with the presence of contrast in the distal bed - filling by collaterals?), presence of a graft from the left internal thoracic artery to the middle third of the patent DA artery and aortic vascular graft occluded in an ostium (Figures 1A, 1B, 1C and 1D).

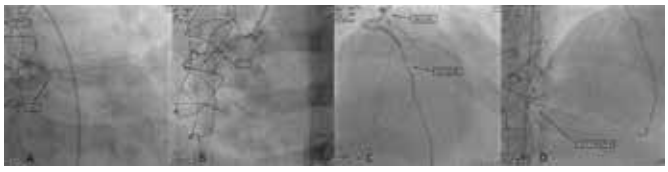

**Figure 1 – Pre-procedure three-vessel pattern: (1A) Circumflex artery occlusion; (1B) Right coronary artery occlusion; (1C) Occlusion in the middle third of the native bed of the anterior descending artery and (1D) Presence of collateral from the anterior descending artery to the right coronary artery.**

Thus, the complex PCI would be carried out in two steps.

The first step was performed on 05/27/2021 with recanalization of the CTO in the CX artery through a 7F femoral access with implantation of a drug-eluting stent (everolimus-eluting 3.0 x 38 mm) at the origin and proximal third of the first left marginal branch and another drug-eluting stent (3.5 x 38 mm everolimus-eluting stent) in the TBI, at the or-

igin and proximal third of the circumflex artery. Due to the presence of significant calcification in the lesions, rotational atherectomy with a 1.75 mm arch followed by balloon angioplasty (2.25x20 mm and 3x20 mm) was necessary. After that, there was still an important residual lesion in the middle third of the marginal branch, so it was decided to use a cutting balloon (3.0x10 mm) with good response. Thus, after adequate preparation of the vascular bed, the stents were implanted and expanded. In this intervention, the rope scaling technique was used, in which the following guidewires (0.014"x180 cm) were required: PT2®, Fielder FC®, Finecross® microcatheter (Figures 2A, 2B, 2C and 2D). After recanalization of the CX artery, the presence of grade 3 collateral circulation to the CD artery was observed.

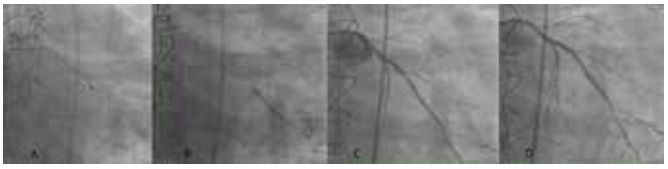

**Figure 2 – First stage of the CTO percutaneous intervention: (2A) Rotational atherectomy with a 1.75 mm arch; (2B) Presence of significant calcification in the circumflex artery after rotational atherectomy; (2C) Result after treatment of a circumflex artery lesion; (2D) Result after treatment of a lesion in the first left marginal branch.**

Additionally, during the procedure, intracoronary ultrasound was used to define the characteristics of the proximal cap and facilitate re-entry into the true lumen, limiting the dissection plane and confirming the distal positioning of the guidewire in the true lumen.

The second stage took place on 08/04/2021 and angioplasty was performed via breast graft and vascular access through the 6F left radial artery with implantation of a drug-eluting stent (everolimus-eluting 3.0 x 18 mm) in the native bed of the AD artery distally to the LITA graft (Figures 3A and 3B).

**Figure 3 – Percutaneous CTO intervention using the retrograde technique: (3A) Injury in the middle third of the anterior descending artery and (3B). Final result after treatment of the anterior descending artery through the left internal mammary graft.**

## DISCUSSION

CHIP-PCI has become a subspecialty in interventional cardiology because it addresses an extensive CAD population in need of revascularization and who have many risk factors for procedural and long-term adverse events. The benefits of revascularization in addition to optimized medical therapy (OMT) in this population have been questioned by some studies, but confirmed in a large meta-analysis with 100 studies covering more than 93,553 patients. Coronary artery bypass graft surgery and PCI with second-generation drug-eluting stents had a similar reduction in mortality compared with medical therapy alone (relative risk [RR], 0.80; 95% CI, 0.70-0.91 and RR, 0.80; 0.75; 95% CI, 0.59-0.96, respectively). Coronary artery bypass graft surgery reduced the risk of infarction compared with BMT (RR 0.79; 95% CI 0.63-0.99) and second-generation stents showed a tendency to reduce the risk of myocardial infarction. (RR 0.75; 95% CI 0.55-1.01) [13].

Kinnaird et. al. (2020) analyzed all CHIP-PCI procedures performed for stable angina in England and Wales between 2007 and 2014. CHIP-PCI was defined by patient characteristics (age ≥80 years, LVEF <30%, CABG surgery previous history or chronic renal failure) and/or by characteristics of the procedure (PCI of the left main coronary artery, chronic total occlusion, left ventricular support, use of rotational atherectomy or laser atherectomy). The authors observed an increase from 28.1% in 2007 to 36.2% in 2014 for CHIP-PCI ($p < 0.001$). Between 2012 and 2014, a total of 30,268 cases of CHIP-PCI were performed [14].

In the study by Riley et. al (2020), data were prospectively collected for PCIs performed during the first 12 months of practice for the lead author and compared to procedures performed in the 12 months prior to the study period. Of the 371 PCIs performed during the study period, 53.4% (198/371) were considered complex, including 126 CTO procedures. Compared to the previous 12 months, there was a significant increase in the number and complexity (median J-CTO score 2.1 vs. 1.3; p 0.04) of CTOs performed during the study period. CTO procedure characteristics and complication rates were similar to those previously published in large US registries, with technical success in 93.4% (118/126) and procedural success in 85.7% (108/126) [15] .

The retrospective study by Neupane et. al. (2020) evaluated the clinical and procedural results of Tandem Heart-assisted CTO-PCI (TH) from April 2016 to January 2019. From the results we have that thirteen CTO-PCIs were assisted by TH (25%), with the the most common reason for hemodynamic support being the use of the retrograde CTO-PCI technique in the case of left ventricular dysfunction (38%). Eleven patients (92%) had decreased left ventricular function with severe symptoms of conges-

tive heart failure before the procedure. The most treated CTO vessel was the right coronary artery in 38% of patients. The retrograde approach was used in 6 PCIs (46%). Technical success was achieved in 12 PCIs (92%) despite very complex and very difficult CTO injuries, as indicated by a median J-CTO score of 3 and CTO Progress score of 2. Procedural success was achieved in 10 patients (77%). The TH was removed at the end of PCI in 11 procedures (85%). There were no major bleeding complications. However, one patient developed an arteriovenous fistula at the arterial cannula insertion site. One patient had coronary perforation requiring pericardiocentesis. One patient died as a result of cardiogenic shock secondary to right ventricular wall hematoma [16].

## CONCLUSION

The evolution of CPI has witnessed unprecedented advances over the past two decades. In the wake of this progress, interventional cardiologists are attempting the revascularization of more complex coronary anatomy in patients often refused surgical intervention. However, with greater complexity comes greater risk, hence the need for new techniques and equipment, as well as the training of specialized operators, increasing the success rate and reducing adverse events.

Although the current evidence is in favor of PCI, good quality prospective randomized controlled trials including complex and high-risk patients are still needed to define the best indications and the most appropriate techniques for intervention in this challenging management population.

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