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Original Article

Impact of occlusion duration on the success rate and outcomes of percutaneous coronary intervention in chronic total occlusions

Antonio de Castro Filho*, Edgar Stroppa Lamas, Mário Barbosa G. Nunes, Dimytri A. Siqueira, Rodolfo Staico, Daniel Chamié, J. Ribamar Costa Jr., Ricardo A. Costa, Alexandre Abizaid

Instituto Dante Pazzanese de Cardiologia, São Paulo, SP, Brazil

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ABSTRACT

Background: Initial studies have shown that old occlusions or those with indeterminate occlusion duration have been associated with percutaneous coronary intervention (PCI) failure and a worse prognosis. This study aimed to determine the impact of occlusion duration on the success and outcomes of contemporary PCI on chronic total occlusion (CTO).
Methods: The authors analyzed a retrospective cohort of consecutive patients submitted to PCI in CTO, who were compared according to the confirmed occlusion duration (COD) < 12 months, ≥ 12 months, or indeterminate occlusion duration (IOD).
Results: A total of 168 patients were treated, 122 (72.6%) with COD (80 < 12 months, 42 ≥ 12 months) and 46 (24.7%) with an IOD. Lesion extension was 17.0 ± 13.6 mm, in 2.90 ± 0.58 mm vessels, and the anterograde approach was used in 98.8% of cases. Angiographic success was attained in 79.2% of patients (80.0% vs. 73.8% vs. 82.6%; $p = 0.73$). The main cause of failure was the inability to cross the lesion with the guidewire (68.6%). Occlusion duration had no impact on in-hospital events (4.8% vs. 7.1% vs. 6.0%; $p = 0.73$), which were almost entirely explained by periprocedural myocardial infarction, or on late outcomes (18.8% vs. 7.1% vs. 15.3%; $p = 0.23$). At the multivariate analysis, lesion length ≥ 20 mm (*odds ratio* - OR = 7.27; 95% confidence interval - 95% IC 1.94-29.1; $p = 0.003$), calcification (OR = 4.72; 95% CI 1.19-19.1; $p = 0.02$), and tortuosity of the occluded segment (OR = 15.98; 95% CI 2.18-144.7; $p = 0.007$) were predictors of failure.
Conclusions: Occlusion duration was not associated with increased failure rate of the procedure or worse PCI outcomes in CTO.

Impacto do tempo de oclusão na taxa de sucesso e nos resultados da intervenção coronária percutânea em obstruções totais crônicas

Palavras-chave:
Doença da artéria coronariana
Intervenção coronária percutânea
Oclusão coronária

RESUMO

Introdução: Estudos iniciais mostram que oclusões antigas ou com tempo indeterminado têm sido associadas a insucesso da intervenção coronária percutânea (ICP) e a pior prognóstico. Nosso objetivo foi determinar o impacto do tempo de oclusão no sucesso e nos resultados da ICP contemporânea na obstrução total crônica (OTC).
Métodos: Analisamos uma coorte retrospectiva de pacientes consecutivos que realizaram ICP em OTC, e que foram comparados de acordo com o tempo de oclusão confirmado (TOC) < 12 meses, ≥ 12 meses, ou indeterminado (TOI).
Resultados: Foram tratados 168 pacientes, 122 (72,6%) com TOC (80 < 12 meses, 42 ≥ 12 meses) e 46 (24,7%) com TOI. A extensão da lesão foi de 17,0 ± 13,6 mm, em vasos de 2,90 ± 0,58 mm, e a abordagem anterógrada foi utilizada em 98,8% dos casos. Sucesso angiográfico foi obtido em 79,2% dos pacientes (80,0% vs. 73,8% vs. 82,6%; $p = 0,73$). A principal causa de insucesso foi a incapacidade de cruzar a lesão com o fio-guia (68,6%). O tempo de oclusão não teve impacto na taxa de eventos cardiovasculares hospitalares (4,8% vs. 7,1% vs. 6,0%; $p = 0,73$), explicados em sua quase totalidade pelos infartos do miocárdio periprocedimento, ou nos eventos tardios (18,8% vs. 7,1% vs. 15,3%; $p = 0,23$). Na análise multivariada, comprimento da lesão ≥ 20 mm (*odds ratio* - OR = 7,27; intervalo de confiança de 95% - IC 95% 1,94-29,1; $p = 0,003$), calcificação (OR = 4,72; IC 95% 1,19-19,1; $p = 0,02$) e tortuosidade do segmento ocluído (OR = 15,98; IC 95% 2,18-144,7; $p = 0,007$) foram preditores de insucesso.

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* Corresponding author: Serviço de Cardiologia Invasiva do Instituto Dante Pazzanese de Cardiologia, Avenida Dr. Dante Pazzanese, 500, Vila Mariana, CEP: 04012-180, São Paulo, SP, Brasil.
E-mail: afilhocastro@gmail.com (A. Castro Filho).
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Conclusões: O tempo de oclusão não está associado ao aumento da taxa de insucesso do procedimento ou a piores resultados da ICP em OTC.

Introduction

Chronic total occlusion (CTO) is found in approximately 15 to 30% of patients referred for elective coronary angiography.[1] However, percutaneous coronary intervention (PCI) for CTO corresponds to only 10% of the total procedures[2,3] and remains one of the most challenging interventions in the field. In fact, the number of percutaneous procedures in CTO has remained stable in recent years,[4] despite the development of new techniques such as the retrograde approach, the use of new dedicated devices, and the increased experience of interventionists, resulting in increasingly higher success rates.[5-8] It is known that a myocardial area irrigated by an occluded artery may be associated with persistent ischemia, even in the presence of well-developed collaterals,[9] and that the successful revascularization of the lesion is associated with reduced ischemic burden and improved ventricular contractility.[10] Studies have shown the improvement in late prognosis of patients submitted to successful PCI compared to those with procedural failure.[11-14] The main reason for this failure is the inability to cross the lesion with the guidewire or the balloon. Initial studies have shown that a long occlusion duration is associated with failure of the technique.[15,16] Similarly, an indeterminate occlusion duration (IOD) is also associated with PCI failure.[17] Conversely, a more recent study showed no association between the occlusion duration and the success rate of the procedure.[18]

The aim of this study was to determine the impact of occlusion duration on the success and outcomes of contemporary PCI in CTO.

Methods

Study population

A retrospective cohort of consecutive patients submitted to PCI in occlusive lesions was assessed from June 2008 to December 2014 in a tertiary cardiology reference hospital linked to the Brazilian Unified Health System (SUS, acronym in Portuguese). After the review of medical records and analysis of coronary angiography, patients who had estimated occlusion duration < 3 months or antegrade coronary flow, with Thrombolysis in Myocardial Infarction (TIMI) > 0, were excluded.

Definitions

CTO was defined as TIMI grade 0 flow in the occluded segment, with estimated occlusion duration > 3 months.[19,20] The levels of certainty of occlusion duration followed the definitions of the European Consensus Euro CTO Club:[19] confirmed occlusion duration (COD) in patients with angiographic evidence of occlusion > 3 months or objective evidence of acute myocardial infarction (AMI) in the occluded coronary > 3 months before the coronary angiography; or IOD in patients with coronary occlusion with TIMI grade zero flow and anatomy suggestive of long-term occlusion (presence of collaterals or absence of contrast retention) with ischemic symptoms unaltered in the last 3 months or evidence of silent ischemia.

Collateral circulation was classified according to Rentrop et al.:[21] grade 0, if there was no visible collateral filling; grade 1, if there was filling of lateral branches of the infarct-related artery, without reaching the epicardial segment; grade 2, if there was partial filling of the epicardial vessel; and grade 3, if there was complete filling of the collateral vessel promoted by the collaterals.

Angiographic success was defined as final residual stenosis < 20% with distal TIMI 3 flow. AMI was defined as an increase in creatine kinase MB isoenzyme (CK-MB) > 3 times the upper limit of normal, associated with electrocardiographic findings and/or symptoms suggestive of ischemia (periprocedural AMI) or increased CK-MB or troponin levels above the 99th percentile of a reference control population (spontaneous AMI). New target vessel revascularization (TVR) was defined as repeat PCI or bypass graft placement for restenosis at the lesion treated during index PCI due to symptoms and/or functional tests, with demonstration of ischemia in the corresponding territory. Contrast-induced nephropathy was defined as an absolute increase in serum creatinine level of 0.5 mg/dL or a 25% increase compared to basal level within 48 hours of the procedure.[22]

Procedure

PCI was performed according to standardized techniques.[19,20] The procedure was indicated for patients with angina or ischemic equivalent and/or ischemia proven in functional tests, being elective in all cases. All patients received acetylsalicylic acid (loading dose of 200 mg and maintenance dose of 100 mg daily) and clopidogrel (loading dose of 300 mg and maintenance dose of 75 mg daily). Unfractionated heparin, at a dose of 100 U/kg, was used to maintain an activated clotting duration > 250 seconds throughout the procedure. The use of glycoprotein IIb/IIIa inhibitors during the procedure was at the discretion of the interventionist, as well as the selection of access route and type of stent. Low-osmolality ionic contrast medium (ioxaglate) was used in all cases, and patients with clearance < 60 mL/minute received isotonic (0.9%) saline for at least 6 hours before and 12 hours after the intervention. Acetylsalicylic acid was maintained indefinitely and clopidogrel was maintained for at least 1 month after bare-metal stents, or 12 months after acute coronary syndrome or when a drug-eluting stent was implanted.

Analyzed outcomes

The primary objective was to evaluate the success rate of the procedure, according to the estimated occlusion duration. The patients were divided into three groups for analysis: < 12 months, ≥ 12 months, or indeterminate. The analyzed secondary outcomes included in-hospital complications and combined major adverse cardiovascular events (MACE), defined as occurrence of death from all causes, AMI, or new TVR, both in-hospital and at the follow-up. Additionally, the authors analyzed MACE at the end of follow-up, according to procedural success or failure.

Coronary angiography was reviewed by two independent interventional cardiologists to determine the anatomical characteristics of lesions and vessels using QAngio® XA software, version 7.3 (Medis