Epidemiology, Management Strategies, and Outcomes of Patients With Chronic Total Coronary Occlusion

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Factors influencing the management of patients with chronic total occlusion (CTO) are poorly described. We sought to analyze the clinical and angiographic variables influencing the decision-making process of patients with CTO. Consecutive patients with at least 1 coronary artery CTO were included and categorized as managed either by percutaneous coronary intervention (PCI), coronary artery bypass graft (CABG), or medical therapy (MT). Patients with previous CABG were excluded. The CTO SYNTAX score (CTO-SS) was defined as the ratio between the score attributed to the CTO lesion in the SYNTAX score calculation and the total SYNTAX score. Independent predictors of management strategies were sought. A total of 510 patients were included (CTO incidence: 20%): 9% were treated with PCI, 34% with CABG, and 57% with MT. SYNTAX score was lowest in PCI (14.8 [11.0 to 18.5]) and highest in CABG (31.5 [25.0 to 38.8], p <0.0001). PCI was attempted more often in patients with higher CTO-SS (i.e., those with higher contribution to the overall SYNTAX score from the CTO lesion; 88% had a CTO-SS >0.5). Conversely, CABG was preferred in subjects with lower CTO-SS (61% had a CTO-SS ≤0.5, p <0.0001). Age, ejection fraction, SYNTAX score, and age of the CTO were independent predictors of revascularization. At mid-term follow-up, unsuccessful revascularization or MT was independently associated with death (hazard ratio 7.2, p = 0.0005). In conclusion, CTOs are frequently documented in clinical practice. However, less than a half is revascularized. Management strategies are influenced by angiographic variables such as the SYNTAX score and the newly proposed CTO-SS. **(Am J Cardiol 2016;■:■−■)**

The management of patients with a chronic total occlusion (CTO) has remained consistently heterogeneous over time and across countries and institutions.[1−5] Indeed, appropriate use criteria guidelines do not provide specific recommendations regarding the optimal revascularization strategy in many frequent clinical scenarios,[6] such as "lone" CTO (1-vessel disease due to a CTO, which is seen in ∼40% of CTO patients[3]). Our study aims were to describe the epidemiology of CTO in the overall coronary artery disease (CAD) population of a high-volume catheterization laboratory without a dedicated CTO program, to analyze the decisional process of the clinicians facing patients with CTO, to identify clinical and angiographic predictors of revascularization, and to analyze the clinical outcomes of these patients at mid-term follow-up.

Methods

All consecutive patients with a coronary CTO (100% stenosis with anterograde Thrombolysis In Myocardial Infarction 0 flow for >3 months), catheterized at our institution from January to October 2014, were included. The only exclusion criterion was a history of coronary artery bypass graft (CABG). As this was a retrospective analysis conducted per institutional guidelines for data security and privacy, a waiver of consent was granted by the local institutional review board.

Preexisting co-morbidities and the indication of coronary angiogram were collected. General angiographic data included the number of narrowed vessels and the SYNTAX score (calculated using the online tool available at http://www.syntaxscore.com/). The CTO SYNTAX score (CTO-SS) was defined as the ratio between the score attributed to the CTO lesion and the SYNTAX score. If >1 CTO was present, the numerator of the CTO-SS was calculated as the sum of the scores attributed to each CTO. A CTO-SS ≤0.5 was considered "low" and a value >0.5 was considered "high." The Japanese chronic total occlusion (J-CTO) score[7] was also calculated for each lesion. In addition, the following variables were analyzed: CTO age, interventional collaterals grade (according to the Werner classification[8]),

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See page 7 for disclosure information.

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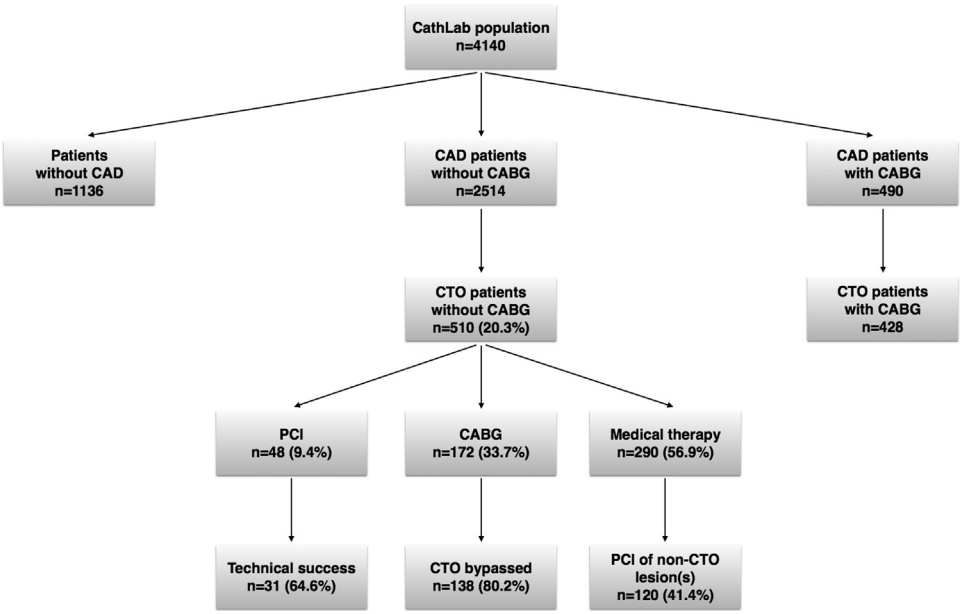

Figure 1. Flowchart of the study population.

Table 1
Clinical characteristics

Variable		Overall (n=510)	PCI (n=48)	CABG (n=172)	Medical therapy (n=290)	*p*
Age (years)		68.6±10.2	60.2±11.2	68.2±8.5	70.1±10.2	<0.0001
Men		407 (80%)	40 (83%)	145 (84%)	222 (77%)	0.11
Body mass index (kg/m^2)		29.2±5.5	30.6±6.2	30.0±5.2	28.5±5.5	0.004
Hypertension		407 (80%)	33 (69%)	141 (82%)	233 (81%)	0.12
Hyperlipidemia		437 (86%)	31 (65%)	154 (90%)	252 (87%)	<0.0001
Diabetes mellitus		191 (37%)	5 (10%)	77 (45%)	109 (38%)	<0.0001
Current smoker		144 (28%)	11 (23%)	48 (28%)	85 (29%)	0.66
Family history of CAD		204 (41%)	22 (48%)	79 (47%)	103 (36%)	0.047
Prior myocardial infarction		128 (25%)	8 (17%)	37 (22%)	83 (29%)	0.09
Prior PCI		185 (36%)	18 (38%)	49 (28%)	118 (41%)	0.030
Peripheral artery disease		93 (18%)	3 (6%)	29 (17%)	61 (21%)	0.042
Prior stroke/transient ischemic attack		44 (9%)	2 (4%)	11 (6%)	31 (11%)	0.14
Chronic kidney disease		108 (21%)	4 (8%)	31 (18%)	73 (25%)	0.014
Canadian Cardiovascular Society angina class	I	74 (15%)	9 (19%)	16 (9%)	49 (17%)	0.07
	II	224 (44%)	17 (35%)	85 (50%)	122 (42%)	
	III	175 (34%)	20 (42%)	53 (31%)	102 (35%)	
	IV	36 (7%)	2 (4%)	17 (10%)	17 (6%)	
Left ventricular ejection fraction (%)		49.2±13.2	52.6±11.6	49.9±12.7	48.2±13.7	0.09
Clinical presentation	STEMI	34 (7%)	3 (6%)	7 (4%)	24 (8%)	0.039
	NSTEACS	208 (41%)	16 (33%)	80 (47%)	112 (39%)	
	Stable CAD	173 (34%)	22 (46%)	62 (36%)	89 (31%)	
	VT/VF	15 (3%)	0	2 (1%)	13 (4%)	
	Heart failure	80 (16%)	7 (15%)	21 (12%)	52 (18%)	
Q waves on ECG	None	250 (50%)	24 (50%)	80 (47%)	146 (52%)	0.67
	Anterior	58 (12%)	4 (8%)	17 (10%)	37 (13%)	
	Inferior	173 (34%)	18 (38%)	66 (38%)	89 (32%)	
	Lateral	22 (4%)	2 (4%)	9 (5%)	11 (4%)	

CABG = coronary artery bypass graft; CAD = coronary artery disease; NSTEACS = non−ST elevation acute coronary syndrome; PCI = percutaneous coronary intervention; STEMI = ST-elevation myocardial infarction; VT/VF = ventricular tachycardia/ventricular fibrillation.

and distal vessel filling (Rentrop grade $\geq$2[9]). All angiograms were reviewed by an interventional cardiologist who had received extensive training at the local quantitative coronary analysis core laboratory.

Patient management was classified as percutaneous coronary intervention (PCI), CABG, or medical therapy (MT). To analyze the decision-making process, the following variables were recorded: the presence of symptoms (angina