

Acute coronary syndrome due to culprit lesions located in unprotected left main coronary artery multifurcations

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INTRODUCTION

The presence of additional branches from the left main coronary artery (LMCA) division is not a rare angiographic finding and may be as frequent as 53% according to a previous study [1]. Intuitively, in the case of atherosclerotic involvement of any left coronary branch, 3 or 4 left coronary branches may offer better protection against ischemia than 2 coronary branches, depending on the plaque location; however, this has not been studied so far.

Percutaneous coronary intervention (PCI) of unprotected LMCA trifurcation/quadrifurcation (multifurcation) presents a challenge, and coronary artery bypass grafting (CABG) seems to be a reasonable option. On the other hand, in the setting of acute coronary syndrome (ACS), surgical treatment is associated with significantly increased perioperative risk, and therefore PCI is usually the method of choice in this group of patients [2]. However, this has only been confirmed for bifurcated LMCA, not for multifurcated LMCA. There is no comparison for PCI outcomes for culprit lesions located in the bifurcated versus trifurcated LMCA in ACS patients.

Aim

We aimed to evaluate the immediate and long-term outcomes for patients with ACS and culprit lesions located in unprotected LMCA multifurcation, treated with PCI or CABG.

METHODS

This was a single-center retrospective observational study. We screened the database of

coronary angiography reports of ACS-patients for the presence of the culprit lesion located in the unprotected LMCA trifurcation-pentafurcation. The studied period was between January 2009 and September 2015. Inclusion criteria were ACS presentation (ST-segment elevation myocardial infarction [STEMI], non-ST-segment elevation myocardial infarction [NSTEMI], and unstable angina [UA]), performed PCI, culprit lesion located in LMCA multifurcation. Patient clinical characteristics were collected in a dedicated database.

Angiography analysis

A significant culprit lesion in the LMCA division was defined as lumen compromise of >50% in the LMCA and/or >70% in any ostia of the proximal branches of LMCA multifurcation or the presence of a thrombus in the LMCA multifurcation in the setting of ongoing ischemia. A simple modification of the Medina classification designed for bifurcation lesions, extended for trifurcation or quadrifurcation lesions [3], was used to categorize the type of LMCA involvement. A binary value (1.0) was given to each of the consecutive segments of the LMCA division and branch ostia according to whether they were compromised or not. A true LMCA trifurcation lesion was defined as disease involving at least 3 of 4 LMCA division segments, and a true LMCA quadrifurcation lesion as involvement of at least 4 of 5 LMCA division segments. The SYNTAX Score was used to calculate the extent of atherosclerosis complexity for the whole coronary tree (low-risk ≤ 22 , intermediate-risk 23–32, and high-risk ≥ 33).

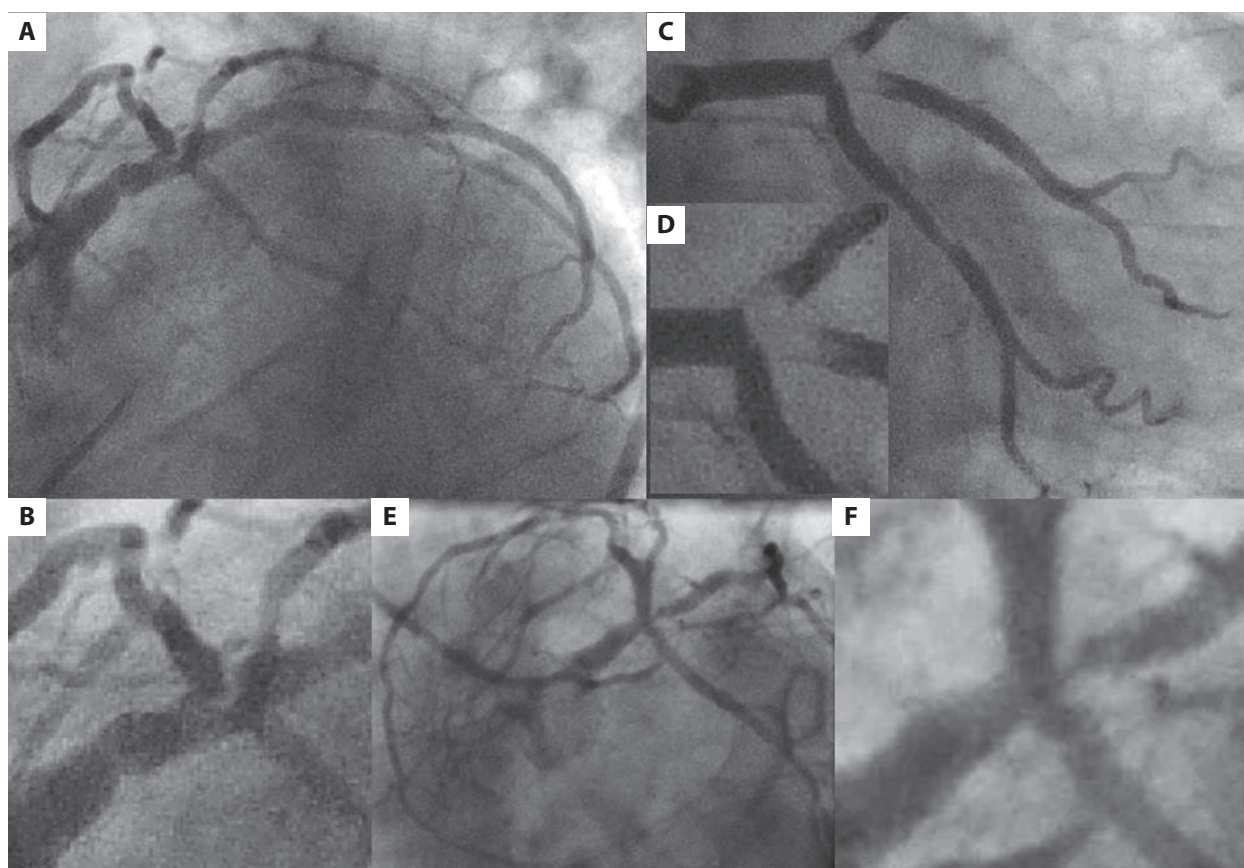


Figure 1. Examples of involvement of the left main coronary artery division by atherosclerotic plaque or thrombus. **A.** Left main coronary artery quadrifurcation with significant stenosis of the distal left main coronary artery. The patient was treated percutaneously. **B.** Magnification of the image **A.** **C.** Large thrombus located at the ostia of the left anterior descending coronary artery and the intermediate branch. Unsuccessful percutaneous treatment with thrombectomy was performed. **D.** Magnification of the image **C.** **E.** Critical ostial stenosis of the intermediate branch. The patient was treated conservatively. **F.** Magnification of the image **E.**

Study endpoints

The primary endpoint was a composite of major adverse cardiovascular events (MACE) defined as cardiac death, recurrent ACS, and target lesion revascularization (TLR) during the follow-up period. Clinical data on all-cause death, cardiac death, non-fatal ACS, stent thrombosis, and TLR, were collected. Clinical information was obtained either from the hospital records, by telephone interviews with the patients and family members, or during clinical visits. ACS was defined as ischemic symptoms and/or ischemic changes on an electrocardiogram plus Troponin T elevation to twice the upper normal limit. TLR was defined as either repeated PCI or CABG due to restenosis within 5 mm proximal or distal of the carina of the LMCA division.

Statistical analysis

Statistical analysis was limited to the simple calculation of the median patient age and median follow-up period.

RESULTS AND DISCUSSION

Baseline patient characteristics, angiographic and treatment details as well as follow-up observations are shown in Supplementary material, *Table S1*.

Eleven patients with ACS due to the culprit lesion located in the LMCA multifurcation were identified (most of them LMCA trifurcations). Among them, 7 patients were treated with PCI only, 1 patient was treated with PCI and delayed CABG and finally, 3 patients were treated with CABG only. The median patient age of the whole cohort was 68 years, interquartile range (IQR): 9.

Subgroup treated with PCI

Three patients presented with STEMI, 3 patients with NSTEMI, and 1 with UA. Among 6 LMCA trifurcations and a single LMCA quadrifurcation, true LMCA division involvement by a significant lesion (see definition above) (**Figure 1**) was diagnosed in 3 cases (all of them LMCA trifurcations). The treatment strategy was mainly based on the patient's hemodynamic stability and the type and extent of coronary artery disease. There were 2 in-hospital deaths (28.5%). The median follow-up of patients treated with PCI after hospital discharge was 41 months, (IQR 28), during which 4 deaths occurred (57.1%). The median ACS-death interval was 41.5 months, (IQR 13.2).

In summary, PCI was undertaken in 5 different scenarios. It was part of a hybrid approach (patient no. 2),

was forced by the patient's instability/cardiogenic shock (patient no. 3, 5, 7), or excessive surgical risk related to redo surgery (patient no. 6). Finally, favorable coronary anatomy in the settings of STEMI (patient no. 8) or the relative safety of opening of chronic total occlusion (patient no. 4) promoted PCI over CABG.

No systematic study of ACS patients due to culprit lesions located at the LMCA dividing into more than 2 branches exists. The first and probably the only case of an ACS patient with LMCA trifurcation treated with PCI has been, so far, reported by Can et al. [4]. The novelty of this retrospective study is reporting on periprocedural outcomes as well as the midterm follow-up of ACS patients who were treated percutaneously due to such an anatomical scenario.

Surgical treatment seems to be the gold standard for such lesion locations in stable patients. However, ACS, especially complicated by hemodynamic instability and unacceptable surgical risk, may force the operator to perform PCI. The goal of PCI in the settings of ACS may not necessarily be the complete percutaneous revascularization, but only the first stage of coronary and hemodynamic stabilization, before the second, hybrid, approach (see patient no. 2).

The type of stenting and procedural success of PCI depends largely on the type of LMCA lesion and the concomitant coronary narrowing. The retrospective report by Chen et al. suggests that in analogy to PCI of a LMCA bifurcation lesion, a one-stent technique may lead to better long-term results compared to a two-stent technique for LMCA trifurcation lesions [5]. Additionally, the utility of the SYNTAX Score has been questioned for the subgroup of patients with LMCA trifurcation. The benefit of a one-stent strategy was supported by a study on another group of patients [6].

As opposed to CABG, the in-hospital and follow-up outcomes for ACS patients treated with LMCA-trifurcation PCI remain unknown.

EuroSCORE in ACS

The predictive value of Euroscore for LMCA PCI outcomes in the settings of ACS is unclear, and for LMCA trifurcation remains unknown. In the study of 200 ACS patients treated with PCI of an unprotected LMCA, elevated EuroSCORE value and pre-procedural hemodynamic instability were the strongest predictors of target lesion failure [7]. A multicenter prospective registry of 138 patients with unprotected LMCA disease with severely narrowed coronary arteries and NSTEMI showed that a EuroSCORE >5 (and surgical revascularization) was an independent risk factor increasing early mortality, while a EuroSCORE >6 was an independent predictor of late mortality [2].

Long-term outcomes

Tamburino et al. [8] reported long-term outcomes after elective PCI for LMCA trifurcation in just 11 patients. Up to 32 months, 3 patients (27%) experienced clinically

driven TLR. No stent thrombosis was observed [8]. In the study by Kubo et al. [6], the incidence of TLR at 3 years was 14.5%, and it was significantly higher in the multi-stent group (31.3%) than in the one-stent group. Further, in the largest registry of patients with LMCA trifurcation disease treated with PCI, the only independent predictor of MACE at follow-up was the presence of true trifurcation disease [9]. Finally, data from a database of patients with LMCA bifurcation disease treated with PCI indicate that involvement of the LCx ostium *per se* does not necessarily adversely affect long-term outcomes [10]. It is unknown, however, if such observations would be confirmed for LCx and/or IM involvement in LMCA trifurcation.

Study limitations

This was a retrospective descriptive and single-center study. The small and heterogeneous sample size precluded any statistical comparison.

CONCLUSIONS

The treatment of choice for culprit lesions located at LMCA multifurcation is surgical revascularization in most cases. However, in selected ACS patients, especially in unstable hemodynamic conditions, immediate PCI may be required. Careful follow-up of patients after such treatment should be considered.

Article information

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