Cardiovascular Revascularization Medicine 16 (2015) 284–289

Contents lists available at ScienceDirect

Cardiovascular Revascularization Medicine

High-speed rotational atherectomy of the left main coronary artery: a single-center experience in 50 high-risk patients

Dmitriy S. Sulimov *, Mohamed Abdel-Wahab, Ralph Toelg, Guido Kassner, Volker Geist, Gert Richardt

Heart Center, Segeberger Kliniken GmbH (Academic Teaching Hospital of the Universities of Kiel, Lübeck and Hamburg), Bad Segeberg, Germany

ARTICLE INFO

Article history:
Received 15 February 2015
Received in revised form 4 May 2015
Accepted 8 May 2015

Keywords:
Atherectomy
Left main disease
Complex lesions
Drug-eluting stent

ABSTRACT

Background: Certain patients with complex calcified left main (LM) disease have a prohibitive risk for bypass surgery. Rotational atherectomy (RA) prior to stent implantation is an option for this subset of patients.
Objective: To analyze acute and long-term results of RA in the LM location.
Methods: We present a single-center analysis of RA in severe LM disease applied in patients with high surgical risk.
Results: RA was performed in the LM location in 50 consecutive patients with a mean age of 73 years. In 30% of the patients clinical presentation was an acute coronary syndrome, and 42% had diabetes. LM bifurcation was involved in 80% of the cases, 36% had a Medina class 1.1.1 lesion, and 38% of RA procedures were performed as bailout. In 38% of patients the left main was protected. Median logistic EuroSCORE was 12.4% (interquartile range, IQR, 5.24–36.11%) and mean SYNTAX Score was 28.6 ± 8.2. The median burr size was 1.5 mm and a two-stent strategy was required in 58% of interventions. Drug-eluting stents were implanted in 86% of procedures. Angiographic success rate was 96%, and in-hospital major adverse cardiac event rate was 10%. Survival free of cardiac death at 12 and 24 months was 87.6% and 78.4%. Target lesion revascularization rates (TLR) were 13.3% and 18.8%, respectively. Cardiac deaths were significantly higher in patients with acute coronary syndromes compared with patients with stable angina (cardiac death free survival was 72.7% and 94% at 12 months, $p = 0.01$). The TLR rate was numerically higher in diabetic patients (21.1% vs. 7.7% at one year, $p = 0.18$).
Conclusion: Acute and long-term outcomes after LM rotational atherectomy are satisfactory, considering the high procedure- and patient-related risks.

1. Introduction

In patients with significant left main coronary artery (LM) disease, coronary artery bypass grafting (CABG) is the preferred revascularization strategy according to the American College of Cardiology/American Heart Association and European Society of Cardiology guidelines [1,2]. Recent randomized studies and meta-analyses comparing surgery and PCI for LM disease have reported similar rates of death and myocardial infarction, lower risk of stroke, and more repeat revascularizations in PCI patients compared to CABG patients [3–8]. Distinctively, guidelines therefore consider percutaneous coronary intervention (PCI) as an option in LM cases with high surgical risk and low anatomical complexity as estimated by the SYNTAX score.

In clinical practice, however, a relevant proportion of patients have both a high surgical risk and a high lesion complexity, which creates a therapeutic dilemma. Rotational atherectomy (RA) is an effective technique for plaque modification and thereby enables PCI even in difficult morphologies such as severely calcified lesions [9]. The degree of coronary calcification has a strong impact on PCI success, because visible calcium decreases the acute success of PCI particularly in the treatment of the LM location. Complex calcified lesions are also known to have worse long-term prognosis compared with non-calcified ones [10,11]. Nevertheless, RA followed by DES implantation can be performed in complex calcified lesions with good acute and long-term results [12–14].

Notably, patients with LM disease were excluded from the recently published randomized ROTAXUS trial, and only limited data about RA of the LM are available in the current literature [15–19]. We therefore present our experience with RA of LM coronary artery disease in 50 patients with high surgical risk because of comorbidities and highly complex mostly calcified lesions.

2. Methods

2.1. Study design and patient population

We performed an observational retrospective analysis of immediate and long-term results of RA in the LM coronary artery. In the period between January 2003 and April 2011 all patients treated with RA were included in a registry for RA procedures. The study cohort comprised all patients with RA in the LM location (protected and unprotected) and attempted stent implantation. The collected data included clinical, angiographic and procedural characteristics and clinical follow-up. The logistic EuroSCORE was used to assess the surgical risk, and the SYNTAX score was used to quantify severity of coronary artery disease [20,21].

* Corresponding author at: Herzzentrum, Segeberger Kliniken GmbH, Am Kurpark 1, 23795 Bad Segeberg – Germany. Tel.: +49 4551 802 4801; fax: +49 4551 802 4805.
E-mail address: dmitriy.sulimov@segebergerkliniken.de (D.S. Sulimov).

http://dx.doi.org/10.1016/j.carrev.2015.05.002
1553-8389/

The SYNTAX score was calculated only for patients without patent grafts. Written informed consent for analysis of anonymized data was obtained from all conscious and stable patients prior to PCI and for all survivors, and data collection was approved by the local ethics committee.

2.2. Procedural details

Procedures in patients with acute coronary syndromes were performed *ad-hoc*. All stable patients were discussed in the local heart team. Procedures were performed via the transfemoral route. RA was defined as elective if no attempts to dilate the lesion or to advance a stent were made before. If RA was performed after failure of balloon/stent delivery or incomplete expansion of the pre-dilatation balloon, the intervention was classified as bailout RA.

Procedural details of RA have been reviewed elsewhere [22]. In brief, a strategy of facilitated expansion was applied in all RA procedures. The burr size was selected to reach a burr/vessel ratio of 0.5 (maximum 0.7 if needed). Rotational speed was set at 150.000–170.000 rpm, and care was taken to prevent any drop in rotational speed >5.000 rpm. A continuous intracoronary infusion containing verapamil, nitroglycerin and unfractionated heparin was used to prevent and control slow-flow. All patients were pre-treated with aspirin and clopidogrel. During intervention, all patients received an intra-arterial unfractionated heparin bolus (70–100 IU/kg) to maintain the activated clotting time at 250–300 s. The use of glycoprotein IIb/IIIa inhibitors was at the operator's discretion. Postprocedural creatine kinase (CK) and CK-MB were routinely measured in all patients. In case of rise over the upper normal level, both measurements were repeated as necessary.

2.3. Quantitative coronary angiography (QCA) analysis

Initial lesion characteristics and procedural results were analyzed by an experienced interventional cardiologist that was not involved in the stenting procedures (DSS). Using the QCA software (QCA-CMS, Version 4, MEDIS medical imaging system, Leiden, The Netherlands), minimal lumen diameter, percent diameter stenosis and reference vessel diameter were measured before and after intervention from diastolic frames in single, matched views showing the smallest lumen diameter. Results of the intervention were analyzed within the stent. The guiding catheter was used for calibration. The reference vessel diameter was calculated automatically. Acute gain was calculated as the difference between the minimal lumen diameter before and after the procedure.

Table 1
Baseline characteristics of the study population.

Clinical characteristics	n = 50
Age (years), mean ± SD	73 ± 8.1
Male sex, n (%)	40 (80%)
Diabetes mellitus, n (%)	21 (42%)
Prior CABG, n (%)	25 (50%)
Logistic EuroSCORE (%), median (IQR)	12.35 (5.24–36.11)
LVEF (%), median (IQR)	50(40–60)
Clinical presentation:	
- Acute coronary syndrome, n (%)	15 (30%)
- Stable angina, n (%)	35 (70%)
Angiographic characteristics	
Protected left main, n (%)	19 (38%)
Number of diseased vessels, median (IQR)	3 (2–3)
Two-vessel disease, n (%)	11 (22%)
Three-vessel disease, n (%)	39 (78%)
Class B2/C lesions, n (%)	48 (96%)
SYNTAX score, mean ± SD	28.6 ± 8.2
Isolated ostial left main, n (%)	2 (4%)
Involvement of bifurcation, n (%)	40 (80%)
Medina class 1.1.1 lesion	18 (36%)

CABG – coronary artery bypass surgery, LVEF – left ventricular ejection fraction.

Table 2
Procedural characteristics.

Rotablation characteristics	n = 50
Elective, n (%)	31 (62%)
Bailout, n (%)	19 (38%)
Balloon dilatation after rotablation, n (%)	45 (90%)
Burr size (mm), median (IQR)	1.5 (1.5–1.75)
Burr/Artery ratio, median (IQR)	0.5 (0.43–0.55)
Stenting characteristics	
Bare-metal stents, n (%)	8 (16%)
First generation DES, n (% from all DES)	26 (62%)
Stent diameter (mm), median (IQR)	3 (3–3.5)
Stent deployment pressure (atm), median (IQR)	18 (16–20)
Post-dilatation, n (%)	39 (78%)
Post-dilatation pressure (atm), mean ± SD	20 (18–26)
Multiple stenting, n (%)	29 (58%)
Total stent length (mm), mean ± SD	28 (18–44)

DES – drug-eluting stents.

2.4. Definitions and follow-up

Protected LM was defined as a status after CABG with at least one patent graft to the left coronary artery. Angiographic success was defined as residual stenosis ≤30% on visual estimation after successful stenting and TIMI 3 flow. Peri-procedural myocardial infarction was defined as elevation of CK-MB more than three times the 99th percentile URL for patients with initially normal CK-MB.

Follow-up was obtained by clinic visit or scripted telephone interview. Major adverse cardiac events (MACE) were defined as death, myocardial infarction (MI), and target lesion revascularization (TLR). Death was adjudicated as cardiac or non-cardiac; death of unknown cause was considered cardiac. Non-fatal spontaneous MI was defined as ischemic symptoms and elevation of CK-MB 2 times the upper limit of normal, with or without ST elevation or development of Q waves. Target lesion revascularization (TLR) was defined as any re-intervention, either PCI or CABG, within the stent implanted during the index procedure or within 5 mm proximal or distal to the stent. Stent thrombosis was defined as proposed by the Academic Research Consortium (ARC) [23].

2.5. Statistical analysis

Statistical analysis was performed using IBM SPSS statistics version 20 (IBM Software, USA). Descriptive analysis was used. Continuous variables with normal distribution are shown as mean ± standard deviation; the non-normally distributed data are presented as median and interquartile range (IQR). An Anderson–Darling test was used to ensure the normality of the distribution. Categorical data are presented as frequencies with percentage. Subgroup comparisons of in-hospital outcome were analyzed with Fisher's exact test. Follow-up events were analyzed with the Kaplan–Meier method. Kaplan–Meier graphs of the incidence of events were constructed from the index procedure to the latest available follow-up. Patients who died during index hospitalization were not excluded and were accepted with a survival time of 0 month. Hazard ratios were calculated to estimate the relative risk of events, and the log-rank test was used to assess the statistical difference between two groups. As usual, a p-value <0.05 was considered statistically significant.

Table 3
QCA-analysis of procedure.

Reference vessel diameter (mm), mean ± SD	3.15 ± 0.59
Minimal lumen diameter (mm), median (IQR)	0.77 (0.54–0.92)
Diameter stenosis (%), median (IQR)	75.53 (67.08–82.03)
Lesion length (mm), median (IQR)	12.32 (9.36–15.13)
In stent minimal lumen diameter (mm), mean ± SD	3.22 ± 0.51
Residual stenosis (in stent, %), median (IQR)	9.84 (6.03–15.88)
Acute gain (mm), mean ± SD	2.41 ± 0.6