Coronary Sinus Reducer implantation in refractory angina: Short-term outcomes based on the Lower Silesia Sinus Reducer Registry (LSSRR)

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INTRODUCTION

Despite the undeniable improvement in the field of pharmacological and interventional treatment of coronary artery disease (CAD), still even up to 10% of patients [1] can experience refractory angina pectoris (RAP)-reversible myocardial ischemia which cannot be adequately controlled despite implementation of all available revascularization and pharmacological therapeutic options [2]. RAP has got heterogeneous pathophysiology and involves patients with CAD unsuitable for revascularization (diffuse disease, high risk-benefit profile; diseases affecting distal segments of arteries) along with other than obstructive CAD coronary disorders. RAP significantly affects values that are important from patients' perspective — the quality of life and mortality rate [3]. Recently, a novel device dedicated to patients with RAP has been introduced into clinical practice [4] which was reflected in the latest European Society of Cardiology (ESC)/European Society of Hypertension (ESH) guidelines [2]. Coronary Sinus (CS) Reducer (Neovasc Inc., Richmond, Canada) is a balloon-expandable hourglass-shaped scaffold implanted percutaneously into the coronary sinus creating a narrowing to delay blood outflow and establishing a backward pressure gradient in the coronary artery system. This promotes blood redistribution from less ischemic to more ischemic myocardial regions. In this brief report, we present short-term outcomes based on the Lower Silesia Sinus Reducer Registry (LSSRR).

METHODS

This observational, single-center, single-arm registry included 22 consecutive patients who were referred to the Cardiac Department of Copper Health Center due to chronic disabling refractory angina pectoris (Canadian Cardiovascular Society [CCS] classes II–IV) despite maximally tolerated anti-angina medical therapy. All patients were evaluated by the local Heart Team and considered not eligible for percutaneous or surgical revascularization procedures. After the Heart Team evaluation, patients were qualified for the procedure of Coronary Sinus Reducer implantation unless they met one of the exclusion criteria. The study exclusion criteria were: (1) recent acute coronary syndrome (<3 months); (2) recent coronary revascularization (<3 months); (3) a mean right atrial pressure higher than 15 mm Hg; (4) CS proximal diameter <10 mm and >14 mm; (5) life expectancy under 12 months; (6) heart failure (New York Heart Association [NYHA] classification, classes III–IV); (7) being a potential cardiac resynchronization therapy defibrilator (CRT-D) implantation candidate.

Initial patient evaluation (before device implantation) consisted of past medical history, actual clinical assessment with an evaluation of CCS class, Seattle Angina

Questionnaire — (SAQ-7) questionnaire, 6-minute walk test (6MWT), and echocardiography. First, a follow-up visit was scheduled 1 month after the implantation procedure. All patients provided informed consent for the Reducer implantation procedure and written consented to participate in this study. The study had the approval of the local ethics community (Lower Silesian Medical Chamber, ref number 02/BOBD/2022, date of approval: 13.07.2022). The study had a license agreement with Outcomes Instruments, LLC, Missouri for the use of SAQ-7 (Project ID: 11117).

Statistical analysis

Depending on the normality of distribution (assessed by the Shapiro-Wilk test), the data were presented as mean with the standard deviation (SD) or median with the interquartile range (IQR). Categorical data were analyzed using the McNemar-Bowker test, continuous data were analyzed using Student's paired t-test or the Wilcoxon paired signed rank test depending on the results of the Shapiro-Wilk test for normality. Changes in CCS levels were compared using the McNemar-Bowker test. For the t-test, a sample mean and 95% confidence interval for mean were used and for the Wilcoxon test, a sample pseudomedian and 95% confidence interval (CI) for pseudomedian were shown. A significance level of alpha = 0.05 was assumed for all tests. All analyses were made using the statistical package R.

RESULTS AND DISCUSSION

We retrospectively analyzed short-term outcomes of 22 consecutive subjects after Reducer device implantation performed between April and September 2022. There were no specific exclusion criteria from the study. In this article, we presented data of all patients qualified for CS Reducer implantation for whom a full 1-month follow-up was available. The vast majority of patients were male (86.3%) at an average age of 71.1 years and with history of previous coronary revascularization. In the study cohort, we noticed a high prevalence of cardiovascular risk factors (hypertension [100%], hyperlipidemia [81.8%], and diabetes [63.6%]). Despite previous revascularization procedures and intensive pharmacological treatment (average of four antianginal drugs per patient), in most subjects, clinical symptoms of angina were poorly controlled (90.9% initially referred with CCS III or IV). In our cohort study, we observed successful implantation of CS Reducer in all subjects. Apart from one case (hospitalization prolonged due to symptomatic gastric ulcer disease), all patients were discharged the next day after the procedure. In terms of clinical outcomes after a one-month follow-up in 9 subjects, we observed an improvement by one CSS class (CCS IV to III — 1 subject; CCS III to II — 6 subjects; CCS II to I — 2 subjects). In 10 patients, we reported the reduction of symptoms by two CSS classes (CCS IV to II — 2 subjects; CCS III to I — 8 subjects). One subject achieved the highest possible improvement in symptom control (de-escalation from CCS IV to CCS I). All clinical data are presented in Table 1.

Refractory angina pectoris is resistant to classical therapeutic options for CAD patients. The prevalence of this disorder is relatively high and can reach up to 5%–10% of the stable CAD population [5]. It is well documented [1, 3, 5] that RAP is associated with poor quality of life, resulting in recurrent hospitalization, leading to a high level of healthcare resource utilization (in our cohort nearly four angina-related hospital admissions in cardiology departments per year for each study subject). In the current article, we present the first Polish experience with CS Reducer. What needs to be emphasized is that so far data available from our country are mainly related to case studies [6, 7].

The main findings of the study are: (1) CS Reducer implantation is a relatively safe procedure. In the presented study cohort despite high comorbidity, no serious adverse events related to the procedure were observed; (2) short-term clinical effectiveness was noticeable and showed a significant improvement in angina control along with an increase in the 6MWT, and in terms of quality of life assessed by the SAQ-7 score.

Despite including the CS Reducer in the guidelines for the management of chronic coronary syndromes [2], still "real-world" data related to the safety and efficacy of this device are limited to small-sized studies [4, 8, 9]. In our study cohort, all procedures finished with successful implantation of the CS Reducer device without any periprocedural complications. All patients were discharged on the following day after the implantation procedure. Similar to our findings, recently published data confirmed the safety and efficacy of the procedure [7–11]. Nevertheless, we observed a slightly higher success rate in comparison to other studies. Our encouraging results are undeniably related to an advanced proctoring program applied in our Cardiac Center along with the relatively high number of procedures performed in a short training period. It allowed achieving a quick gain of the necessary experience and flattened the learning curve. The clinical outcomes obtained in our registry are encouraging, and we noticed a statistically significant improvement in all evaluated angina gauges (6MWT and CCS score). Additionally, significant improvement was observed in terms of the quality-of-life rate (SAQ-7 score). All data regarding clinical outcomes were pooled in Table 1.

The present study has limitations that should be acknowledged. It is a single-center observational registry with a relatively small number of enrolled patients and the absence of a control group. Additionally, the study refers to short-term outcomes mainly related to the quality-of-life parameters. Despite these limitations, the study included the largest number of patients treated with CS Reducer in Poland and confirmed the short-term safety and clinical efficiency of the CS Reducer device in a real-world setting.

Table 1. LSSRR clinical data

Variables	Study cohort (n = 22)
Age, mean (SD)	71.1 (7.2)
Male sex, n (%)	19 (86.3)
Female sex, n (%)	3 (13.6)
BMI, kg/m^2, mean (SD)	29.4 (4.4)
Hypertension, n (%)	22 (100)
Type 2 diabetes mellitus, n (%)	14 (63.6)
Hyperlipidemia, n (%)	18 (81.8)
Cigarette smoker, n (%)	7 (31.8)
Atrial fibrillation, n (%)	7 (31.8)
Peripheral arterial disease, n (%)	11 (50)
LVEF, %, median (IQR)	55 (40–60)
Heart failure, n (%)	9 (40.9)
Coronary artery disease — illness duration, years, mean (SD)	18.4 (8.3)
Antianginal drugs, median (IQR)	4 (3–4.75)
Admissions to Department of Cardiology — during previous year, median (IQR)	3 (3–4.75)
History of revascularization	
PCI, n (%)	19 (86.4)
CABG, n (%)	18 (81.8)
PCI + CABG, n (%)	15 (68.2)
History of ACS	
STEMI, n (%)	8 (36.4)
NSTEMI, n (%)	8 (36.4)
STEMI + NSTEMI, n (%)	2 (9.1)

Change in CCS class[1]						*P* = 0.003
CCS class		1-month FU				
		I	II	III	IV	Total
Baseline	I	0	0	0	0	0 (0%)
	II	2	0	0	0	2 (9.1%)
	III	8	6	2	0	16 (72.7%)
	IV	1	2	1	0	4 (18.2%)
	Total	11 (50%)	8 (36.4%)	3 (13.6%)	0 (0%)	22 (100%)

6MWT	Baseline	1-month FU	*P*-value	Group difference and CI
Distance, m, mean (SD)	224.4 (99.9)	300.7 (124.1)	<0.001	76.33 (41.5–111.14)
Duration, sec, median (IQR)	360 (247.5–360)	360 (338.5–360)	0.02	79.48 (20–162.5)
Borg's scale score, mean (SD)	3.05 (1.36)	1.68 (1.36)	0.001	–1.36 (–2.11 to –0.62)
SAQ-7	**Baseline**	**1-month FU**	***P*-value**	**Group difference and CI**
SAQ-7 total score, mean (SD)	33.3 (13.88)	54.53 (19.44)	<0.001	21.24 (12.16–30.32)
SAQ-7-PL, mean (SD)	35.23 (18.71)	54.17 (22.23)	<0.001	18.94 (9.39–28.49)
SAQ-7-AF median (IQR)	40 (22.5–57.5)	65 (52.5–80)	0.001	30 (15–45)
SAQ-7-QL median (IQR)	18.75 (12.5–37.5)	43.75 (25–59.4)	<0.001	25 (12.5–43.75)

[1]Table cells colored red correspond to an increase in CCS grade, yellow cells correspond to no change in CCS grade, green cells correspond to a decrease in CCS grade

Abbreviations: 6MWT, six-minute walk test; ACS, acute coronary syndrome; BMI, body mass index; CABG, coronary artery bypass grafting; CCS, Canadian Cardiovascular Society; CI, mean or pseudomedian difference 95% confidence interval; FU, follow-up; LVEF, left ventricular ejection fraction; NSTEMI, non-ST-segment elevation myocardial infarction; PCI, percutaneous coronary intervention; SAQ-7, Seattle Angina Questionnaire — 7 items; SAQ-7-AF, Angina Frequency Score; SAQ-7-PL, Physical Limitation Score; SAQ-7-QL, Quality of Life Score; SD, standard deviation; STEMI, ST-segment elevation myocardial infarction

Article information

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REFERENCES

1. Povsic TJ, Henry TD, Ohman EM. Therapeutic approaches for the no-option refractory angina patient. Circ Cardiovasc Interv. 2021; 14(2): e009002, doi: 10.1161/CIRCINTERVENTIONS.120.009002, indexed in Pubmed: 33541098.
2. Knuuti J, Wijns W, Saraste A, et al. 2019 ESC Guidelines for the diagnosis and management of chronic coronary syndromes. Eur Heart J. 2020; 41(3): 407–477, doi: 10.1093/eurheartj/ehz425, indexed in Pubmed: 31504439.
3. Gallone G, Baldetti L, Tzanis G, et al. Refractory angina: from pathophysiology to new therapeutic nonpharmacological technologies. JACC Cardiovasc Interv. 2020; 13(1): 1–19, doi: 10.1016/j.jcin.2019.08.055, indexed in Pubmed: 31918927.

4. Jolicoeur EM, Verheye S, Henry TD, et al. Efficacy of a device to narrow the coronary sinus in refractory angina. N Engl J Med. 2015; 372(6): 519–527, doi: 10.1056/NEJMoa1402556, indexed in Pubmed: 25651246.
5. Mannheimer C, Camici P, Chester MR, et al. The problem of chronic refractory angina; report from the ESC Joint Study Group on the Treatment of Refractory Angina. Eur Heart J. 2002; 23(5): 355–370, doi: 10.1053/euhj.2001.2706, indexed in Pubmed: 11846493.
6. Wojciech Z, Kuliczkowski W, Reczuch K. Coronary sinus reducer implantation in patients with refractory angina: first experience in Poland. Kardiol Pol. 2021; 79(4): 471–472, doi: 10.33963/KP.15866, indexed in Pubmed: 33687874.
7. Wańczura PM, Stecko W, Curzytek A, et al. Coronary sinus reductor - a novel approach in "no-option" patients. Postepy Kardiol Interwencyjnej. 2021; 17(2): 242–243, doi: 10.5114/aic.2021.107514, indexed in Pubmed: 34400935.
8. Giannini F, Baldetti L, Ponticelli F, et al. Coronary Sinus Reducer Implantation for the Treatment of Chronic Refractory Angina: A Single-Center Experience. JACC Cardiovasc Interv. 2018; 11(8): 784–792, doi: 10.1016/j.jcin.2018.01.251, indexed in Pubmed: 29673511.
9. D'Amico G, Giannini F, Massussi M, et al. Usefulness of coronary sinus reducer implantation for the treatment of chronic refractory angina pectoris. Am J Cardiol. 2021; 139: 22–27, doi: 10.1016/j.amjcard.2020.09.045, indexed in Pubmed: 32998007.
10. Mrak M, Pavšič N, Ponticelli F, et al. Efficacy of coronary sinus reducer implantation in patients with chronic total occlusion of the right coronary artery. Kardiol Pol. 2022; 80(1): 25–32, doi: 10.33963/KP.a2021.0132, indexed in Pubmed: 34643262.
11. Konigstein M. Coronary sinus Reducer: An adjunctive tool for the treatment of patients with chronic total occlusion of the right coronary artery. Kardiol Pol. 2022; 80(1): 1–2, doi: 10.33963/KP.a2022.0001, indexed in Pubmed: 34981825.