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Coronary sinus reducer implantation for refractory angina: a national audit of UK practice

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R. Al-Lamee has served on the advisory boards of Janssen Pharmaceuticals, Abbott, Philips and Shockwave; and has received speaker honoraria from Shockwave, Abbott, Philips, Medtronic, Servier, Omniprex and Menarini.

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Data availability statement: Data are available upon reasonable request to the corresponding author.

Patient and Public Involvement: Patients and/or the public were not involved in the design, or conduct, or reporting, or dissemination plans of this research.

Abbreviations:

AE	Adverse event
CABG	Coronary artery bypass grafting
CAD	Coronary artery disease
CCS	Canadian Cardiovascular Society
CMD	Coronary microvascular dysfunction
CSR	Coronary sinus reducer
ESC	European Society of Cardiology
LVEF	Left ventricular ejection fraction
MACE	Major adverse cardiac event
MRI	Magnetic resonance imaging
NICE	National Institute for Health and Care Excellence
PCI	Percutaneous coronary intervention
RCT	Randomised controlled trial
SAE	Serious adverse event
SD	Standard deviation

ABSTRACT

Background: Coronary sinus reducer (CSR) implantation is the only guideline-recommended percutaneous treatment for patients with refractory angina. Data from its real-world large-scale adoption are scarce.

Methods: This was a national audit of CSR implanting centres in the United Kingdom between November 2014-2024. Centres provided data on all patients undergoing clinical CSR implantation through a structured collection template. Data collected included demographics, medical history, medications, angina status, ischaemia testing, procedural characteristics and peri-procedural complications. Pre-specified endpoints were appropriate patient selection, procedural success and safety, and efficacy of CSR implantation.

Results: Nineteen centres were included capturing 491 patients. Most were male (79%) with high rates of previous myocardial infarction (75%), PCI (78%) and CABG (69%). Diabetes mellitus (53%), hypertension (76%) and hypercholesterolaemia (78%) were prevalent. Seventy-four percent had a preserved left ventricular ejection fraction (LVEF≥50%). Patients were severely symptomatic with 84% suffering from Canadian Cardiovascular Society (CCS) class ≥3 angina despite multiple anti-anginal medications (≥2 drugs: 94%; ≥3 drugs: 74%). Baseline ischaemia testing was common (79%). Successful CSR implantation was achieved in 95% of cases. Forty-six peri-procedural adverse events (AEs) in 41 patients occurred (9.2%) most commonly due to access complications. Rates of major adverse cardiovascular events and severe AEs were low (<1%). Ninety-eight percent of patients stayed ≤1 night post-procedurally. Significant reductions in CCS were observed at 6-month follow-up: 75% experienced ≥1 CCS class and 36% ≥2 CCS class angina reduction. Improved angina status was also observed after stratification by age, sex and diabetes mellitus.

Conclusions: This national audit of real-world UK practice confirms CSR implantation is being performed appropriately and safely leading to symptom improvement for patients with refractory angina. Contemporary practice aligns with the

recommendations of current guidelines supporting the continued use of CSR in UK clinical practice. Prospective data collection within a national registry is warranted.

What is already known on this topic Coronary sinus reducer (CSR) implantation is an emerging percutaneous therapy for patients with refractory angina. National and international guidelines exist. However, data from its real-world large-scale adoption are lacking.
What this study adds This was a national audit of 19 UK centres between 2014-2024 and confirms that CSR implantation is being performed appropriately adhering to guideline recommendations with high rates of procedural success and low rates of complications. In this real-world cohort, significant improvements in physician-adjudicated angina were observed.
How this study might affect research, practice or policy Prospective data collection within a national registry is needed. The results of this study will also support the inclusion of CSR implantation within national policy for the management of the growing population of patients with refractory angina.

Introduction

Coronary sinus reducer (CSR; Shockwave Medical Inc.) implantation is the only guideline-recommended percutaneous treatment for patients with refractory angina despite optimised medical therapy, no achievable revascularisation options, and demonstrable myocardial ischaemia [1-3]. Randomised, double-blinded, sham-controlled trials report improvements in physician-adjudicated and patient-reported symptoms, and quality of life [4, 5]. In refractory angina due to advanced coronary artery disease (CAD), symptom benefit is proposed to result from redistribution of myocardial blood flow towards the most ischaemic myocardium, particularly the subendocardium [5-9].

With increasing recognition of the burden and morbidity of refractory angina, CSR implantation has emerged as a potential therapy. European adoption is growing and with increasing interest worldwide, data from real-world large-scale adoption are needed. CSR implantation has been performed in the UK since 2014 with many centres having contributed to the major randomised controlled trials (RCTs) and registries evaluating this device.

National UK guidance recommends audit of patients undergoing this therapy [10]. In accordance with this, we performed a national audit of CSR practice to assess alignment with guideline recommendations for patient selection, procedural success and safety, and efficacy of CSR implantation.

Methods

We performed a retrospective audit of clinically-indicated CSR implants in UK centres between 08/11/2014 and 07/11/2024 (Table S1). Operators were asked to complete a structured data collection template for all consecutive patients undergoing clinical CSR implantation. Data included patient demographics, medical history including anti-anginal medication, physician-adjudicated symptom status, ischaemia testing, procedural characteristics and peri-procedural complications.

The primary outcomes were clinical suitability for CSR implantation, procedural success and safety, and change in angina adjudicated by Canadian Cardiovascular Society (CCS) class at 6 months. Operator-adjudicated procedural success was defined as a successful CSR implant at an appropriate location within the coronary sinus. The primary safety endpoint was the percentage of patients experiencing an operator-adjudicated adverse event (AE) during implantation. Major adverse cardiac events (MACE), serious adverse events (SAE) and AEs were defined according to previous studies [11, 12].

In line with Health Research Authority guidelines (https://www.hra-decisiontools.org.uk/research), this study was classed as service evaluation and registered with the Quality and Safety Department of the lead site (Royal Brompton Hospital; project ID: 7194). Data reporting adhered to STROBE guidelines.

Data analysis

Depending on the distribution, continuous variables are presented as mean±standard deviation or median±interquartile interval. Normality of distribution was assessed using histograms. Categorical variables are presented as percentages. Comparisons between baseline and follow-up measures used either the paired Student's *t*-test or Wilcoxon signed rank test for continuous variables, Kruskal-Wallis test for continuous variables across baseline CCS class, and the Chi-squared or Fisher's exact test for categorical variables. Univariable linear regression identified baseline predictors of change in CCS class after CSR implantation. A backwards stepwise linear regression model was performed, including all candidate predictors, with variables sequentially removed at a threshold of $P>0.1$. $P<0.05$ was considered statistically significant. Missing data was excluded listwise. Statistical analyses used SPSS 24 and GraphPad Prism.

Results

Baseline demographics

Nineteen implanting centres returned data. A total of 497 CSR implant procedures in 491 patients were captured. Table 1 shows baseline demographics. The annual number of patients undergoing CSR implantation is shown in Figure 1. Most patients were male (79%) with a previous myocardial infarction (75%) or percutaneous (78%) or surgical revascularisation (69%). A high proportion had diabetes mellitus (53%), hypertension (76%) and hypercholesterolaemia (78%). A preserved left ventricular ejection fraction (LVEF≥50%) was observed in 74% of patients.

Clinical appropriateness & patient selection

Angina severity and anti-anginal therapy

Median baseline CCS class was 3.0±0.6. Most patients (84%) had CCS class ≥3 angina. Ninety-four percent of patients were on ≥2, whilst 74% were on ≥3 baseline anti-anginal drugs, most commonly beta-blockers (76%), long-acting nitrates (72%) and ranolazine (66%) (Table S2). Patient demographics by individual centre are provided in Table S3.

Ischaemia assessment

Non-invasive ischaemia testing before CSR implantation was performed in 79% of patients (n=377) (Table S4). Most commonly, patients underwent stress perfusion cardiac MRI (47%) followed by nuclear (31%) and stress echocardiography (22%).

In those patients reported to have inducible ischaemia by functional testing or the presence of angiographically significant epicardial CAD (n=412/491 [84% with available data; 65 patients had data missing on presence or location of ischaemia]), almost all had left-sided ischaemia (n=372/412; 90%). Of these, 196 (48%) had isolated left-sided and 176 (43%) had both left and right-sided ischaemia. Isolated right-sided ischaemia were the minority (n=40/412; 10%). Two-thirds of centres (12/18 who returned available data) reported ≥75% of patients having a baseline ischaemia test (Table S3).

Procedural characteristics & success

In total, 497 initial and repeat procedures were performed in 491 patients. Successful CSR implantation was achieved in 95%. Twenty-three initial implants were unsuccessful (Table 2) with 6 patients returning for a repeat successful attempt. Table S5 summarises procedural characteristics. Almost all procedures occurred via right internal jugular vein access (98%). Mean procedural time was 58mins (±29), median fluoroscopy time 14mins (9-22) and median contrast volume 40ml (30-70). The most commonly used diagnostic catheter to access the coronary sinus was a multipurpose (67%), whilst an Amplatz left was used in 28% of cases. The pre-supplied STR catheter (89%) was the most common delivery catheter. A mother-in-child technique was used in 62% of cases.

Procedural characteristics by individual centre (Table S6) show the predominant use of right internal jugular venous access and conventional catheters. Centres mainly used one of either the standard or mother-in-child techniques for delivery catheter introduction. High procedural success was observed across centres (94%; 17/18 centres achieved ≥90% procedural success). Additionally, 83% (15/18 centres) reported a median procedural time of ≤60mins.

Peri-procedural AEs, time to discharge & institutional experience

Forty-six peri-procedural AEs occurred in 41 patients (9.2%, 46/497 implant procedures, Table 3). There were no procedural deaths. Rates of MACE (0.4%) and peri-procedural SAE (0.8%) were low. The most common AEs were access complications (n=20; 4.8%). Ten cases of coronary sinus dissection (2.0%) and 9 device embolisations (1.8%) occurred, of which 5 were successfully snared or retrieved (further details in Table S7). Wire perforation (n=1) and tamponade (n=1) were rare.

Eighty-one percent of procedures were performed as day cases and 98% of patients had ≤1 night stay in hospital. Patients hospitalised for ≥1 night post procedure were

more likely to have experienced an AE (same day discharge after AE: 22/322; ≥1 day discharge after AE: 17/55; OR: 4.52; 95% CI: 2.31-8.97; P<0.0001, Table S8).

There was no difference in procedural times when stratified by case volume (<20 cases: median procedure time 51mins [35-68], 20-50 cases: 55mins [35-76], >50 cases: 54mins [40-80]; P=0.45). No difference in rates of AE were observed when stratified by case volume (<20, 20-50, >50 cases; P=0.91, Table S8) or institutional experience (<3, 3-6, >6 years; P=0.82, Table S9) of performing CSR implantation.

Change in angina status

Baseline demographics of the subgroup (n=305) who underwent successful CSR implantation and had available 6-month CCS data are presented in Table S10. A significant reduction in CCS class was observed (median difference -1.00; P<0.0001; Figure 2A & 2B). Seventy-five percent experienced ≥1 and 36% experienced ≥2 CCS class reduction. In 24% there was no change in CCS class (Figure 2C). The greatest benefit was observed in patients with the most severe baseline anginal symptoms (Figure 2D).

Univariable regression analyses using change in CCS class as a continuous variable showed that baseline CCS class was negatively correlated suggesting the greatest improvements occurred in the most symptomatic patients (Table 4). In multivariable analysis, only baseline CCS and age remained independently associated with CCS change (Table 5).

In patients with reported medication at follow-up (n=351), the number of anti-anginal medications remained unchanged (P=0.13). Stratified by number of baseline anti-anginal medications, significant reductions in CCS class were observed irrespective of the number of baseline drugs (Figure 3A). We observed a trend towards greater magnitudes of CCS class reduction in patients on fewer baseline anti-anginal medications (P=0.07).

CCS class significantly improved in patients with both left- and right-sided ischaemia (Figure 3B; n=117, median difference: -1.00), isolated left-sided ischaemia (n=141, median difference: -1.00) and right-sided ischaemia (n=30, median difference: -1.00; all P<0.0001). Improvements in CCS class were observed in females as well as males (both P<0.0001), patients <60 years (n=71) and ≥60 years of age (n=234; both P<0.0001) and in patients with (n=168) and without diabetes (n=137; both P<0.0001).

Discussion

To our knowledge, this study reports the largest national audit of CSR practice to date. Our data demonstrate adherence to national and international guideline recommendations for patient selection. CSR implantation is performed with high procedural success and low complication rates. In this real-world cohort, significant benefits in physician-adjudicated angina were observed consistent with the results of two RCTs and international registries [4, 5, 11, 12].

Clinical appropriateness

Compared with other national and international cohorts, patients in the UK had a similar demographic profile with high rates of percutaneous or surgical revascularisation and cardiovascular risk factors, in particular diabetes mellitus [11, 12]. Patients in the UK were severely symptomatic. Most had CCS class ≥3 angina despite being well-medicated and ischaemia testing was frequently performed in their work-up. These findings align with ESC and NICE guidance and highlight the importance of patient selection as evidence suggests the greatest benefit from CSR occurs in those with the most severe angina and ischaemic burden [4, 5, 11].

Procedural success & safety

Technical challenges related to CSR implantation have been reported [13, 14]. Our data confirm high rates of procedural success. Procedure and fluoroscopy time, and contrast

usage were similar to previous cohorts [11, 12]. Implants were commonly performed as day-cases.

The most common complication related to vascular access. There were no procedural deaths. Device embolisation and retention in the pulmonary circulation has been previously reported however long-term sequelae are unknown and follow-up of these patients should be undertaken. Whilst experience by case volume or years performing CSR implantation were not associated with rate of AE, the occurrence of AEs was associated with extended post-procedure hospital stay. This highlights the need for particular attention to vascular access technique, such as systematic use of ultrasound to minimise complications.

The observed safety of CSR implantation, its high procedural success, symptom benefit, combined with the results of published studies, support consideration of this intervention as an alternative to high-risk complex revascularisation procedures that are considered to improve anginal symptoms and quality of life. CSR implantation does not preclude these options in the future if needed. However, this strategy requires further evaluation.

Efficacy

Physician-adjudicated CCS class significantly improved after CSR, consistent with previous reports [4, 11]. Whilst increasing age was statistically associated with symptom response, baseline CCS class was the strongest predictor of treatment response (Table 5). Our data also suggest benefits across the spectrum of patients with angina irrespective of age, sex, diabetes, ischaemia location, and baseline number of anti-anginal medications.

Women with angina represent an unmet clinical need [15, 16]. To date, most CSR studies have enrolled predominantly men. Our data indicate significant reductions in CCS class in both women and men suggesting no sex disparity in treatment response. Diabetes mellitus is associated with more complex and difficult to treat phenotypes of

obstructive epicardial CAD, such as multi-vessel and diffuse disease, as well as coronary microvascular dysfunction (CMD) [17]. After CSR implantation, CCS class in patients with diabetes mellitus significantly improved suggesting its utility for this group of patients who represent one-third of patients with refractory angina [18].

CSR implantation has conventionally been thought to benefit patients with left-sided ischaemia due to the venous drainage of the left ventricle occurring via the coronary sinus. The right ventricle either drains directly into the cavity or through veins that join close to the ostium of the coronary sinus and may not be impacted by the CSR. Preliminary reports have raised the hypothesis that CSR may benefit patients with right-sided ischaemia potentially explained by the inferior wall whose venous drainage is via the posterior (middle) cardiac vein and can still be impacted by proximal CSR implantation [19]. Mapping venous anatomy to the ischaemic myocardium drained may help provide future insights. The improvements in patients with chronic total occlusions of the right coronary artery have been hypothesised to be mediated by effects of CSR on non-ischaemic myocardium leading to increased supplementary perfusion to ischaemic myocardium via collaterals. Our data support effects on right-sided ischaemia but require further evaluation.

Finally, non-responders represented 24% of our cohort consistent with previous data. This may be explained by well-developed alternative venous drainage of the left ventricle through the Thebesian system, inappropriate patient selection, inappropriate coronary sinus size, incomplete device endothelialisation, progression of epicardial CAD and limited baseline ischaemia [3]. Few studies have investigated these mechanisms. It has been suggested that coronary sinus systolic wedge pressure during coronary sinus occlusion during CSR deployment may predict symptom response [20]. Greater increments in wedge pressure may indicate poorer alternative venous drainage and potentially identify those most likely to benefit but further investigation is needed.

Procedural volumes over time

Over the audit period, the number of implants has been increasing in the UK (Figure 1). This observation reflects an appreciation of the increasing burden of refractory angina and the role of CSR in the management of these complex patients [21]. The growth in the UK over this period is consistent with the increasing adoption of this technology across Europe. Whilst data from individual centres suggest little variation in patient selection and procedural characteristics (Table S3 & S6), standardisation of patient selection algorithms may streamline the appropriate work-up of these patients, particularly the imaging pathways for baseline ischaemia detection.

Infrastructure for the systematic national collection of cardiac procedural data exist and has been expanded beyond percutaneous coronary interventions to include structural interventions such as transcatheter valvular interventions and occluder devices. Given the increasing volume of CSR implantation in the UK, it would seem appropriate to consider inclusion of this procedure. For the purposes of prospective data collection and future audit, we suggest collection of a mandatory minimum dataset that includes parameters encompassing procedural factors, peri-procedural complications and clinical outcomes including angina status.

Several studies have modelled the health economic benefits of CSR implantation on the Italian healthcare system but data within the UK National Health Service is lacking [22, 23]. National data collection will enable health economic modelling specific to the UK which is of interest given the REDUCER-1 registry recently showed a reduction in Emergency Department visits at 12 months after CSR implantation as a driver of healthcare cost savings [24]. Various registries on CSR implantation exist (Table S11). Countries newly adopting CSR implantation have developed their own national registries (e.g. France) and similar methods for UK data collection should be considered [25]. This data will support the inclusion of CSR implantation within UK national policy for the management of refractory angina.

Finally, CSR implantation remains the only treatment recommended by the latest ESC guidelines for patients with refractory angina, maintaining its Class IIb, Level of Evidence B recommendation based on two RCTs, several large registries and meta-

analyses [1]. It highlights the major limitations of the evidence base of all novel therapies for refractory angina being small sample sizes and short follow-up. The ongoing pivotal COSIRA-2 study [NCT05102019], the largest double-blinded, sham-controlled RCT of CSR implantation in patients with refractory angina and advanced CAD began enrolment in the UK in 2025. Its findings will address key knowledge gaps, including effects of CSR on exercise time, symptoms and changes in myocardial perfusion.

Patients with refractory angina may have ischaemic mechanisms responsible for their symptoms beyond obstructive epicardial CAD [21] for which CSR may be a biologically plausible therapy [26-28]. These patients with ischaemia and non-obstructed coronary arteries (INOCA) represent a large proportion of those investigated for refractory symptoms, either with or without previous revascularisation [21, 29, 30]. As we increasingly understand the mechanism of action of CSR implantation and its effects on the microcirculation, its role in the treatment of patients with refractory angina with CMD will be defined by several ongoing RCTs (REMEDY-PILOT [NCT05492110], COSIMA [NCT04606459] and REDUCE CMD [NCT06898541]).

Limitations

Whilst this represents the only UK-wide study performed to date, and one of the largest cohorts reported, several limitations should be considered. These include its retrospective nature, single country design, limited follow-up, data collected from healthcare records and missing data (e.g. baseline renal function and CCS class had >10% missing). Listwise deletion of missing data may introduce bias if the missingness is not completely at random, introduce selection bias of patients with complete data, and reduce sample size and statistical power increasing the chance of false negatives. Finally, whilst most implanting centres were included, not all were captured, making the total number of CSR implants performed likely greater than reported.

The primary efficacy analysis of change in CCS class is a physician-adjudicated rather than patient-reported outcome, is limited by a lack of randomisation and blinding, and

therefore susceptible to a placebo effect. Whilst our results align with two placebo-controlled RCTs, future prospective data collection would be strengthened by standardised patient-reported health outcomes such as the Seattle Angina Questionnaire.

Follow-up was limited to 6 months. No longer-term safety endpoints or angina status were collected. Therefore, this study is unable to inform on durability of symptom relief, rehospitalisation and the health economic impact of this therapy. Future work should aim to capture quality of life changes, health economic evaluations and the patient perspective. Nevertheless, this audit remains useful in providing real-world experience of patient selection, procedural success and safety as well as symptom improvement, which encouragingly is similar to those reported in sham-controlled RCTs that have employed more granular assessments of angina status.

Conclusion

This current study of real-world UK practice confirms that CSR implantation is being performed appropriately and safely, resulting in symptom improvement for patients with refractory angina who have exhausted conventional guideline-directed treatments. These results are consistent with previously reported trials and registries. Furthermore, these data demonstrate that UK CSR practice aligns with current guidelines, and these data support the continued use of CSR as a treatment option for patients with refractory angina in the UK. Prospective data collection within a national registry is warranted.

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Figure Legends:

Figure 1. Number of patients undergoing coronary sinus reducer (CSR) implantation per year

Figure 2. Subgroup analysis of change in Canadian Cardiovascular Society (CCS) class in patients undergoing successful CSR implantation with available follow-up (n=305). Baseline and 6-month CCS class shown as A) median (interquartile interval) and B) percentages. Change in CCS class is shown by C) percentage of patients and D) baseline CCS class.

Figure 3. CCS class at baseline and 6-month follow-up (median & interquartile interval) stratified by A) number of baseline anti-anginal medications B) location of ischaemia.

Table Legends:

Table 1. Baseline demographics

Table 2. Procedural details

Table 3. Adverse peri-procedural events

Table 4. Univariable linear regression to identify predictors of change in CCS class after CSR implantation.

Table 5. Multivariable linear regression to identify predictors of change in CCS class after CSR implantation.

Table 1. Baseline demographics				
Demographics		**Absolute number of patients (n)**	**%**	**Missing data (%)**
Sex	**Male**	388	79%	0.0%
	Female	103	21%	
Previous MI		366	75%	1.2%
Previous PCI		379	78%	0.8%
Previous CABG		337	69%	0.8%
Diabetes		257	53%	1.2%
Hypertension		362	76%	2.2%
Family history of IHD		156	35%	9.4%
Hypercholesterolaemia		371	78%	2.9%
Smoking	**Never**	271	58%	5.3%
	Ex	156	34%	
	Current	37	8%	
Previous PPM/ICD		33	7%	1.6%
LVEF	**<50%**	106	26%	8.1%
	≥50%	306	74%	
Renal function (eGFR)	**≥60**	288	72%	19%
	31-59	94	24%	
	≤30	16	4%	
Baseline CCS class	**Mean (±SD)**	3.0 ± 0.6		15%
	1	1	0%	
	2	69	17%	
	3	271	66%	
	4	70	17%	
Baseline number of anti-anginal medications	**≥2**	444	94%	3.9%
	≥3	348	74%	
	≥4	185	39%	

CABG: coronary artery bypass grafting; CCS: Canadian Cardiovascular Society; eGFR: estimated glomerular filtration rate; ICD: implantable cardioverter defibrillator; IHD: ischaemic heart

disease; LVEF: left ventricular ejection fraction; MI: myocardial infarction; PCI: percutaneous coronary intervention; PPM: permanent pacemaker.

Table 2. Procedural details			
	No. of patients	**% of patients**	**Missing data**
Procedural success at first attempt	467/490	95%	1.4%
Reasons for unsuccessful procedures (n=23):			
Adverse event	9		
CS too small	4		
Technical issues (e.g. unable to deliver equipment, CSR device displacement off balloon)	5		
Lack of internal jugular venous access	1		
Not recorded	4		
CS: coronary sinus; CSR: coronary sinus reducer			

Table 3. Adverse peri-procedural events (total = 46 events in 41 patients out of 497 implant procedures)		
Type of adverse event	**Number**	**% of procedures**
Access complications (neck haematoma, bleeding, carotid puncture)	20	4.0%
Stroke	1	0.2%
Coronary sinus dissection	10	2.0%
Wire perforation/tamponade	2	0.4%
Device embolisation	9	1.8%
Procedural death	0	0.0%
Other (NSTEMI, pAF, heart failure hospitalisation)	4	0.8%
NSTEMI: non-ST segment elevation myocardial infarction; pAF: paroxysmal atrial fibrillation.		

Table 4. Univariable linear regression to identify predictors of change in CCS class after CSR implantation.			
Predictor	**Unstandardised correlation co-efficient (B)**	**Standard error (SE)**	**P value**
Age	-0.009	0.005	0.09

Baseline CCS class	-0.42	0.09	**<0.001**
Baseline number of anti-anginals	-0.03	0.05	0.51
Previous PCI	0.10	0.14	0.46
Previous CABG	0.04	0.12	0.73
Diabetes	-0.007	0.11	0.95
LVEF	0.002	0.006	0.78
Male sex	0.03	0.14	0.83
Ischaemia location			
Left	0.18	0.19	0.34
Left + Right	0.08	0.12	0.49
Right	0.01	0.11	0.92

CABG: coronary artery bypass grafting; CCS: Canadian Cardiovascular Society; CSR: coronary sinus reducer; LVEF: left ventricular ejection fraction; PCI: percutaneous coronary intervention.

Table 5. Multivariable linear regression to identify predictors of change in CCS class after CSR implantation.

Predictor	Unstandardised correlation co-efficient (B)	Coefficients standard error (SE)	Standardised Coefficients Beta	t	P value
Baseline CCS class	-0.486	0.1	-0.287	-4.883	<0.001
Age	-0.013	0.006	-0.132	-2.240	0.026

R=0.303; R^2=0.092; Adjusted R^2=0.085

CCS: Canadian Cardiovascular Society; CSR: coronary sinus reducer