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Safety and performance of the ultrathin sirolimus-eluting coronary stent in an all-comer patient population: the S-FLEX UK-II registry

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ABSTRACT

Objective We evaluated the clinical safety and performance of the ultrathin strut biodegradable polymer-coated Supraflex Cruz (Sahajanand Medical TechnologiesLtd., Surat, India) sirolimus-eluting stent (SES) in an all-comer patient population requiring coronary stent implantation.

Study design The study was a prospective, observational, multicentre, single-arm registry.

Study settings The study was conducted at 19 NHS Hospitals across the UK, from March 2020 to September 2021.

Study participants A total of 1904 patients with symptomatic coronary artery disease (age ≥18 years) who underwent percutaneous coronary intervention with at least one Supraflex Cruz SES were enrolled.

Primary and secondary outcomes measure The primary endpoint was target lesion failure (TLF), a composite of cardiac death, target vessel myocardial infarction (TV-MI) and clinically indicated target lesion revascularisation (CI-TLR), at 12 months. Safety endpoints were stent thrombosis, all-cause death and any MI. Prespecified subgroups analysis included patients with diabetes mellitus, bifurcation lesion, type B2/C lesion defined as per ACC/AHA (American College of Cardiology/American Heart Association) lesion classification and long coronary lesions (>20 mm).

Results A total of 2973 Supraflex Cruz SES were implanted in 1835 patients (mean age: 65.20±11.03 years). Of these, 404 patients had diabetes mellitus (491 lesions), 271 had bifurcation lesions (293 lesions), 1541 had type B2/C lesions (1832 lesions) and 985 had long coronary lesions (>20 mm, 1139 lesions). Among the overall population, device success was achieved in 98.2% of lesions. TLF occurred in 12 (0.7%) patients (0.3% cardiac death, 0.2% TV-MI, 0.2% CI-TLR) at 30 days and in 43 (2.3%) patients (0.8% cardiac death, 0.8% TV-MI, 0.8% CI-TLR) at 12 months follow-up. The rate of definite stent thrombosis was 0.3% in the overall population at 12 months. The incidence of TLF and stent thrombosis was 6.2% and 1% in the diabetic, 1.8% and none in bifurcation lesion, 2.5% and 0.3% in type B2/C lesion, and 2.7% and 0.3% in long coronary lesions (>20 mm) subgroups, respectively. at 12 months follow-up.

Conclusion The S-FLEX UK-II registry confirms the clinical safety and performance of the ultrathin Supraflex Cruz SES in an all-comer population with complex coronary artery disease, demonstrating low rates of TLF and stent thrombosis.

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STRENGTHS AND LIMITATIONS OF THIS STUDY

⇒ The strength of this study was its real-world setup to include an all-comer patient population.
⇒ The inclusion of a high proportion of high-risk patients, such as those with diabetes, bifurcation lesions, complex type B2/C lesions and long coronary lesions (>20 mm), enhances the relevance of the study in addressing complex cases.
⇒ The execution of revascularisation and postoperative management was operator guided - further enhancing the real-world design and purpose of this study.
⇒ The study was non-randomised and lacked a direct comparator.
⇒ The follow-up was conducted for up to 12 months with data beyond this time point not collected.

INTRODUCTION

Successive improvements in the design characteristics of drug-eluting stents (DESs) have led to reduced rates of restenosis and stent thrombosis in patients with symptomatic coronary artery disease (CAD). The latest generation DESs have demonstrated safety and effectiveness reflected in good clinical outcomes. Nevertheless, there remains a potential link between the occurrence of late or very late stent thrombosis with a combination of thick stent struts and polymer-mediated inflammatory reaction together with delayed healing and incomplete re-endothelialisation. Consequently, iterations of DES, featuring biodegradable polymer

coatings and ultrathin struts, have emerged to mitigate this potential drawback of second-generation DES with the goal of further improving clinical outcomes.[1 2] The Supraflex Cruz (Sahajanand Medical Technologies Ltd., Surat, India), represents the next generation of Supraflex stent and is a biodegradable polymer-coated sirolimus-eluting stent (SES) engineered on an ultrathin cobalt-chromium platform with open-cell design and dual valley-to-valley connection between strut rings with alternate long dual Z-link (LDZ) to enhance deliverability in complex and challenging coronary lesions.

Optical coherence tomography (OCT) imaging studies have revealed, rapid/uniform vascular healing with equivalent neointimal thickness with Supraflex Cruz SES compared with the Xience stent.[3 4] However, there is limited real-world evidence on Supraflex Cruz SES, with available data primarily focused only on the South Asian population.[5 6] Therefore, the S-FLEX UK-II registry was designed to evaluate the clinical safety and performance of the Supraflex Cruz SES in a real-world, all-comer patient population with CAD in the UK. The registry prespecified high-risk subgroups for analysis—patients with diabetes mellitus, patients with bifurcation lesions, patients with type B2/C lesions and patients with long coronary lesions (>20 mm).

METHODS

Study design and population

The S-FLEX UK-II registry was a prospective, observational, single-arm, multicentre registry designed to evaluate the clinical safety and performance of Supraflex Cruz SES in an all-comer patient population. A total of 1904 patients (aged ≥18 years) who underwent percutaneous coronary intervention (PCI) with at least one Supraflex Cruz SES at 19 NHS Hospitals across UK, from March 2020 to September 2021, were enrolled.

The inclusion criteria were age ≥18 years, symptomatic CAD including patients with acute coronary syndrome (ACS) or chronic coronary syndrome, and clinical indication for PCI, signed informed consent for participation in registry and willing to participate in all follow-up assessments as per protocol. The exclusion criteria were patients with cardiogenic shock, known hypersensitivity or contraindication to aspirin, clopidogrel, heparin or any other anticoagulation/antiplatelet therapy required for PCI, cobalt chromium, sirolimus or contrast media, planned surgery within 12 months of PCI, pregnancy, life expectancy of less than 1 year and participating in a clinical study of another drug or medical device.

Patient and public involvement

Patients and/or the public were not involved in the design, conduct, reporting or dissemination plans of this study.

Study device

The Supraflex Cruz stent is built on ultrathin L-605 cobalt chromium alloy (60 µm). It has an open-cell design and dual valley-to-valley connection between strut rings with alternate LDZ orientation. The stent has a conformal coating of sirolimus drug (1.4 µg/mm^2) in a blend with biodegradable polymers (4–6 µm). The multilayer drug polymer coating comprises a combination of hydrophobic (PLLA: poly-L-lactic acid and PLCL: poly (L-Lactide-co-ε-Caprolac-tone)) polymers blended with sirolimus in the middle and innermost layer, and the outer drug-free hydrophilic polymer (polyvinylpyrrolidone) coating. Nearly 80% of drug is released within 1 month with the remaining drug programmed to be released at a slow rate over 3 months. The polymers are gradually degraded and excreted in the form of biologically inert molecules within 10–12 months. Supraflex Cruz SES is available in a wide range of sizes—diameter of 2.00–4.50 mm and length of 8–48 mm.

Interventional procedure and follow-up

Lesion severity was assessed by visual estimation after invasive coronary angiography and revascularisation and postoperative management was done in accordance with physician practice. Dual antiplatelet therapy was recommended for at least 12 months in patients with ACS and 6 months in patients with stable CAD. All patients were followed up via clinic visit or telephonic communication at 30 days and 12 months after PCI. Angiographic data were collected for patients readmitted with clinical symptoms of ischemia. For those who underwent angiographic re-evaluation within 12 months of stent implantation, image analysis was conducted to assess whether disease progression had occurred in the previously stented segment, including peristent areas 2 mm adjacent to the stent, or if it was limited to arterial segments remote from the stented region.

In our study, all events were investigator reported without any event adjudication committee. However, to ensure continuous protocol compliance and accurate data reporting, periodic site monitoring was carried out by Psephos Biomedica (Sussex Innovation Centre, University of Sussex, Brighton BN1 9SB, UK).

Study endpoints and definition

The primary endpoint was the rate of target lesion failure (TLF) defined as a composite of cardiac death, target vessel myocardial infarction (TV-MI) and clinically indicated target lesion revascularisation (CI-TLR) by percutaneous or surgical methods at 12 months. The secondary safety endpoints included overall stent thrombosis (definite/probable), all-cause death (cardiac, vascular and non-cardiovascular) and MI at 12 months. The secondary efficacy endpoints included repeat revascularisation (target lesion, target vessel or non-target vessel revascularisation (TVR)) at 12 months. We also recorded target vessel failure (TVF) which was a composite of cardiac

Table 1 Baseline clinical characteristics

Characteristics		Total (n=1835)	Diabetes (n=404)	Bifurcation (n=271)	Lesion B2/C (n=1541)	Long lesion (>20 mm) (n=985)
Age, years		65.20±11.03	65.96±10.49	65.59±10.66	65.21±11.13	65.15±10.86
Gender	Male	1406 (76.6%)	312 (77.2%)	216 (79.7%)	1189 (77.2%)	773 (78.5%)
	Female	429 (23.4%)	92 (22.8%)	55 (20.3%)	352 (22.8%)	212 (21.5%)
Height cm		171.27±10.37 (1782/1835)	171.10±9.20 (395/404)	171.63±9.66 (267/271)	171.39±10.31 (1495/1541)	171.60±10.06 (952/985)
Weight, kg		86.00±17.50 (1803/1835)	90.88±18.03 (398/404)	85.71±17.68 (269/271)	86.09±17.66 (1514/1541)	86.54±18.02 (966/985)
Body mass index, kg/m^2		29.41±6.15 (1779/1835)	31.07±5.91 (395/404)	29.14±5.54 (267/271)	29.40±5.94 (1492/1541)	29.48±6.26 (950/985)
Coexisting illness and addiction						
Diabetes mellitus		404 (22.0%)	404 (100.0%)	62 (22.9%)	351 (22.8%)	228 (23.1%)
Insulin requiring		81/394 (20.5%)	81/394 (20.5%)	10/61 (16.3%)	72/341 (21.1%)	45/222 (20.27%)
Non-Insulin requiring		313/394 (79.4%)	313/394 (79.4%)	51/61 (83.6%)	269/341 (78.8%)	177/222 (79.7%)
Hypertension		939 (51.2%)	275 (68.1%)	138 (50.9%)	788 (51.1%)	496 (50.4%)
Renal insufficiency		54 (2.9%)	23 (5.7%)	12 (4.4%)	46 (3.0%)	29 (2.9%)
Family history of CAD		705 (38.4%)	136 (33.7%)	111 (41.0%)	575 (37.3%)	361 (36.6%)
Peripheral vascular disease		85 (4.6%)	33 (8.2%)	20 (7.4%)	71 (4.6%)	53 (5.4%)
Smoker		388 (21.1%)	76 (18.8%)	44 (16.2%)	331 (21.5%)	211 (21.4%)
Hypercholesterolaemia		865 (47.1%)	232 (57.4%)	142 (52.4%)	719 (46.7%)	441 (44.8%)
Congestive heart failure		45 (2.5%)	16 (4.0%)	9 (3.3%)	33 (2.1%)	21 (2.1%)
Transient ischaemic attack		47 (2.6%)	14 (3.5%)	7 (2.6%)	38 (2.5%)	24 (2.4%)
Previous stroke		39 (2.1%)	17 (4.2%)	4 (1.5%)	35 (2.3%)	21 (2.1%)
Previous MI		270 (14.7%)	88 (21.8%)	41 (15.1%)	229 (14.9%)	145 (14.7%)
Previous PCI		312 (17.0%)	94 (23.3%)	49 (18.1%)	266 (17.3%)	165 (16.8%)
Previous CABG		98 (5.3%)	28 (6.9%)	15 (5.5%)	94 (6.1%)	60 (6.1%)
Clinical presentation						
NSTEMI		730/1830 (40.0%)	185/403 (45.9%)	102 (37.6%)	583/1538 (37.91%)	377/983 (38.4%)
STEMI		417/1830 (22.8%)	63/403 (15.6%)	44 (16.2%)	376/1538 (24.45%)	229/983 (23.3%)
Unstable angina		110/1830 (6.0%)	25/403 (6.2%)	24 (8.9%)	92/1538 (6.0%)	53/983 (5.4%)
Silent ischaemia		10/1830 (0.5%)	2/403 (0.5%)	0 (0.0%)	8/1538 (0.5%)	6/983 (0.6%)
Stable angina		563/1830 (30.8%)	128/403 (31.8%)	101 (37.3%)	479/1538 (31.1%)	318/983 (32.3%)
Extent of CAD						
Single vessel disease		1039 (56.6%)	230 (56.9%)	119 (43.9%)	852 (55.3%)	511 (51.9%)
Multiple vessel disease		796 (43.4%)	174 (43.1%)	152 (56.1%)	689 (44.7%)	474 (48.1%)

Continued

Table 1 Continued

Characteristics	Total (n=1835)	Diabetes (n=404)	Bifurcation (n=271)	Lesion B2/C (n=1541)	Long lesion (>20 mm) (n=985)
Left ventricular ejection fraction					
Good (≥60%)	479/1821 (26.3%)	106/401 (26.4%)	85 (31.4%)	406/1530 (26.5%)	261/981 (26.6%)
Moderate (>35% to <60%)	660/1821 (36.2%)	152/401 (37.9%)	97 (35.8%)	542/1530 (35.4%)	356/981 (36.3%)
Severe (≤35%)	85/1821 (4.7%)	29/401 (7.2%)	16 (5.9%)	79/1530 (5.2%)	45/981 (4.6%)
Unknown	597/1821 (32.8%)	114/401 (28.4%)	73 (26.9%)	503/1530 (32.9%)	319/981 (32.5%)

Data are mean (SD), n (%) or n/n (%) in case of missing data.
CABG, coronary artery bypass grafting; CAD, coronary artery disease; MI, myocardial infarction; NSTEMI, non-ST-elevation myocardial infarction; PCI, percutaneous coronary intervention; STEMI, ST-elevation myocardial infarction.

death, TV-MI and clinically indicated TVR at 12 months as a secondary endpoint.

Device success was defined as the successful delivery and deployment of the study device (Supraflex Cruz SES) at the designated target lesions, along with successful retrieval of the stent delivery system and achievement of final residual stenosis of <30% on visual estimation. Procedure success was defined as the achievement of device success without any adverse cardiac event occurring during hospital stay. Cardiac death was defined as death due to any cardiac mechanisms (fatal arrhythmia, sudden death, MI or low cardiac output heart failure), any unwitnessed death, death of unknown cause or procedural-related death. Target vessel MI was defined as target vessel Q-wave or non-Q-wave MI with the evidence of myocardial necrosis in the vascular territory of the previously treated target vessel. MI was adjudged according to the fourth universal definition.[7] The TLR was defined as any repeat revascularisation by percutaneous or surgical means of any part of the target lesion including 5 mm proximal and distal to the stent. Clinically indicated TLR was defined as any repeat revascularisation for in-lesion diameter stenosis of >50% by quantitative coronary angiography (QCA) and the presence of ischaemic signs and symptoms attributable to the target lesion, or any repeat revascularisation done for in-lesion diameter stenosis of >70% and absence of ischaemic signs and symptoms, or presence of severe ischaemic signs and symptoms attributable to the target lesions in the absence of QCA data and if in-lesion diameter stenosis is ≤50%.[8] TVR was defined as any repeat revascularisation by percutaneous or surgical means of any segment of the target vessel including the target lesion.[8] Stent thrombosis was defined according to Academic Research Consortium-2 definition.[8]

Statistical analysis

Continuous variables are expressed as mean±SD, while categorical variables are presented as frequency (percentage). The cumulative rate of events up to 12 months was estimated by using the Kaplan-Meier method. Additionally, a subgroup analysis was undertaken, wherein clinical outcomes were evaluated for patients with diabetes mellitus (patient was a known diabetic and on pharmacological treatment or documented HbA1c >7% even if not on pharmacological treatment), bifurcation coronary lesions, type B2/C lesions (defined according to ACC/AHA (American College of Cardiology/American Heart Association) lesion classification[9]) and long coronary lesions (target lesion length of >20 mm). The data were analysed by using R Statistical Software V.4.3.1.

RESULTS

Baseline characteristics

Of 1904 enrolled patients, a total of 1835 patients were included in the analysis (online supplemental figure 1). The mean age was 65.20±11.03 years, >75% were male and 22% (n=404) had diabetes mellitus of which 20.5%

Table 2 Lesion characteristics

Characteristics	Total (2230 lesions)	Diabetes (491 lesions)	Bifurcation (293 lesions)	Lesion B2/C (1832 lesions)	Long lesion (>20 mm) (1139 lesions)
Target vessel					
Left anterior descending artery	935 (41.9%)	188 (38.3%)	174 (59.4%)	756 (41.3%)	456 (40.0%)
Right coronary artery	769 (34.5%)	185 (37.7%)	39 (13.3%)	651 (35.5%)	437 (38.4%)
Left circumflex artery	445 (20.0%)	96 (19.6%)	43 (14.7%)	347 (18.9%)	199 (17.5%)
Left main artery	60 (2.7%)	13 (2.6%)	36 (12.3%)	57 (3.1%)	36 (3.2%)
Saphenous vein grafts	21 (0.9%)	9 (1.8%)	1 (0.3%)	21 (1.1%)	11 (1.0%)
Lesion characteristics					
AHA/ACC lesion classification					
Type A	41/2067 (2.0%)	6/462 (1.3%)	0 (0.0%)	_	0 (0.0%)
Type B1	194/2067 (9.4%)	34/462 (7.4%)	11/287 (3.8%)	_	0 (0.0%)
Type B2	560/2067 (27.1%)	128/462 (27.7%)	76/287 (26.5%)	560 (30.6%)	0 (0.0%)
Type C	1272/2067 (61.5%)	294/462 (63.6%)	200/287 (69.7%)	1272 (69.4%)	1139 (100.0%)
Length					
Discrete (<10 mm)	220/2054 (10.7%)	39/460 (8.5%)	24/285 (8.4%)	117/1824 (6.4%)	–
Tubular (10–20 mm)	695/2054 (33.8%)	156/460 (33.9%)	77/285 (27.0%)	568/1824 (31.1%)	–
Diffuse (>20 mm)	1139/2054 (55.5%)	265/460 (57.6%)	184/285 (64.6%)	1139/1824 (62.4%)	1139 (100.0%)
Eccentricity					
Concentric	991/1950 (50.8%)	220/441 (49.9%)	141/282 (50.0%)	784/1734 (45.2%)	490/1095 (44.7%)
Eccentric	959/1950 (49.2%)	221/441 (50.1%)	141/282 (50.0%)	950/1734 (54.8%)	605/1095 (55.3%)
Accessibility					
Readily accessible tortuosity of proximal segment	1534/2019 (76.0%)	341/450 (75.8%)	222/284 (78.2%)	1316/1792 (73.4%)	819/1117 (73.3%)
Moderate tortuosity of proximal segment	434/2019 (21.5%)	101/450 (22.4%)	59/284 (20.8%)	425/1792 (23.7%)	270/1117 (24.2%)
Excessive	51/2019 (2.5%)	8/450 (1.8%)	3/284 (1.1%)	51/1792 (2.8%)	28/1117 (2.5%)
Lesion angulation					
None (<45°)	1485/1978 (75.1%)	326/444 (73.4%)	186/283 (65.7%)	1263/1753 (72.0%)	778/1109 (70.2%)
Moderate (≥45° and <90°)	450/1978 (22.8%)	109/444 (24.5%)	92/283 (32.5%)	447/1753 (25.5%)	299/1109 (27.0%)
Location in severe bend point, (≥90°)	43/1978 (2.2%)	9/444 (2.0%)	5/283 (1.8%)	43/1753 (2.5%)	32/1109 (2.9%)
Lesion contour					
Smooth	1004/2020 (49.7%)	204/454 (44.9%)	132/284 (46.5%)	787/1793 (43.9%)	460/1117 (41.2%)
Irregular	1016/2020 (50.3%)	250/454 (55.1%)	152/284 (53.5%)	1006/1793 (56.1%)	657/1117 (58.8%)
Bifurcation or side branch lesions					
No major branch involvement	1719/2058 (83.5%)	378/460 (82.2%)	43/287 (15.0%)	1492/1821 (81.9%)	910/1136 (80.1%)
Bifurcation lesions requiring double guidewire	317/2058 (15.4%)	76/460 (16.5%)	236/287 (82.2%)	307/1821 (16.9%)	211/1136 (18.6%)
Inability to protect major side branches	22/2058 (1.1%)	6/460 (1.3%)	8/287 (2.8%)	22/1821 (1.2%)	15/1136 (1.3%)
Degenerated bypass grafts with unstable lesions	30/1914 (1.6%)	6/417 (1.4%)	5/254 (2.0%)	30/1663 (1.8%)	14/1035 (1.4%)
Lesion complexity					

Continued

Table 2 Continued

Characteristics	Total (2230 lesions)	Diabetes (491 lesions)	Bifurcation (293 lesions)	Lesion B2/C (1832 lesions)	Long lesion (>20 mm) (1139 lesions)
Lesion requiring overlapping stents	540 (24.2%)	110 (22.4%)	99 (33.8%)	493 (26.9%)	424 (37.2%)
Restenotic lesion	52 (2.3%)	16 (3.3%)	6 (2.0%)	48 (2.6%)	29 (2.5%)
Bifurcation	293 (13.1%)	64 (13.0%)	293 (100.0%)	276 (15.1%)	184 (16.2%)
Moderate to heavy calcification	612/2038 (30%)	163/461 (35.3%)	92/284 (32.4%)	606/1807 (33.5%)	431/1138 (37.9%)
Ostial (within 3 mm of vessel origin)	269/2035 (13.2%)	55/457 (12.0%)	68/284 (23.9%)	263/1805 (14.6%)	164/1136 (14.4%)
Thrombus	471/2074 (22.7%)	90/464 (19.4%)	45/287 (15.7%)	464/1827 (25.4%)	272 (23.9%)
Total Occlusion (<3 months)	351/2062 (17.0%)	65/463 (14.0%)	33/285 (11.6%)	345/1825 (18.9%)	192/1138 (16.9%)
Chronic Total Occlusion (≥3 months)	185/2062 (9.0%)	44/463 (9.5%)	29/285 (10.2%)	185/1825 (10.1%)	143/1138 (12.6%)

Data are n (%) or n/n (%) in case of missing data.
ACC/AHA, American College of Cardiology/American Heart Association.

(n=81) were dependent on insulin. A total of 410 (22.3%) patients had a history of revascularisation either via PCI or coronary artery bypass grafting. A majority of patients (68.7%, n=1257/1830) presented with ACS and 43.4% (n=796) patients were diagnosed with multivessel CAD. Moderate left ventricular dysfunction (ejection fraction <60% and >35%) was reported in 36.2% (n=660) patients and severe left ventricular dysfunction (ejection fraction ≤35%) in 4.7% (n=85) patients. The baseline clinical characteristics of the entire cohort and four prespecified subgroups are outlined in table 1.

Lesion and procedural characteristics

In the overall cohort of 1835 patients, 2230 lesions were treated with implantation of 2973 Supraflex Cruz SES. The detailed lesion and procedural characteristics are summarised in tables 2 and 3, respectively. Of all treated lesions, 88.6% lesions were type B2/C, 13.1% were bifurcation lesions, 55.5% (1139/2054) were long diffuse lesions (>20 mm) and 13.2% were ostial lesions (within 3 mm of vessel origin). A total of 30% (612 lesions) lesions were moderately or heavily calcified, thrombus was visible in 22.7% (471 lesions) and 9% (185 lesions) were chronic total occlusions (≥3 months occlusion). Overall, the mean reference vessel diameter was 3.29±1.01 mm and represented mean diameter stenosis of more than 90%. During the procedure, predilatation was performed in 2043 (91.6%) lesions and postdilatation in 1879 (84.3%) treated lesions.

Device success was achieved in 98.2% (2189/2230) lesions with procedural success in 97.7% (1792/1835) patients. The details of antiplatelet medication and other cardiac medications prescribed at discharge and its adherence at 30 days and 12 months follow-up are outlined in online supplemental tables 1 and 2, respectively.

Study outcomes

Clinical outcomes at 30 days and 12 months follow-up are presented in table 4. At 12 months follow-up, the cumulative incidence of TLF, the primary endpoint, was 2.3% (n=43) comprising 0.8% (n=14) cardiac death, 0.8% (n=14) TV-MI and 0.8% (n=15) CI-TLR. At 12 months, 34 (1.9%) patients underwent TVR, and 43 (2.3%) patients underwent non-TVR. The overall rate of definite/probable stent thrombosis was 0.3% at 12 months. In prespecified subgroups, the incidence of TLF and stent thrombosis was 6.2% and 1% in diabetes mellitus subgroup, 1.8% and none in bifurcation subgroup, 2.5% and 0.3% in type B2/C lesion subgroup, and 2.7% and 0.3% in long lesions (>20 mm) subgroup at 12 months follow-up, respectively. The time-to-event Kaplan-Meier curves up to 12 months follow-up are presented in figure 1 and online supplemental figure 2A–D.

DISCUSSION

The findings of this multicentre, single-arm, prospective registry demonstrate the safety and efficacy of the latest generation Supraflex Cruz ultrathin SES in an all-comer UK population. Our findings revealed a low incidence of the primary endpoint of TLF at 2.3% and the safety endpoint of definite or probable stent thrombosis of 0.3% at 12 months follow-up.

Technical iterations of the latest generation DES such as ultrathin struts with improved design and biodegradable polymer coating have improved clinical outcomes and reduced stent-related complications. The suggested mechanisms for the observed improvements are the reduction in risk of acute/chronic inflammation and vessel wall injury, accelerated re-endothelialisation and

Table 3 Procedural characteristics

Characteristics	Total (2230 lesions)	Diabetes (491 lesions)	Bifurcation (293 lesions)	Lesion B2/C (1832 lesions)	Long lesion (>20 mm) (1139 lesions)
Reference vessel diameter, mm	3.29±1.01 (2004/2230)	3.27±0.55 (452/491)	3.28±0.57 (282/293)	3.29±0.93 (1778/1832)	3.30±1.09 (1129/1139)
Diameter stenosis, %	90.18±10.76 (2041/2230)	89.78±11.57 (459/491)	88.14±12.28 (285/293)	90.56±10.53 (1812/1832)	91.30±9.91 (1134/1139)
Pre dilatation	2043 (91.6%)	450 (91.6%)	279 (95.2%)	1706 (93.1%)	1091 (95.8%)
Maximum inflation pressure pre stent, atm	13.69±3.43 (1930/2230)	13.70±3.77 (424/491)	14.14±3.25 (267/293)	13.97±3.08 (1605/1832)	14.15±3.04 (1024/1139)
Postdilatation	1879 (84.3%)	416 (84.7%)	273 (93.2%)	1560 (85.2%)	1012 (88.8%)
Maximum inflation pressure poststent, atm	16.95±3.78 (1804/2230)	16.49±3.80 (394/491)	17.06±2.95 (262/293)	17.11±3.38 (1491/1832)	17.22±3.11 (973/1139)
Stents	n=2973 Stents	n=657 Stents	n=432 Stents	n=2554 Stents	n=1754 Stents
No. of stents per patient, mm	1.62±0.93	1.63±0.87	1.59±0.85	1.66±0.95	1.78±0.98
No. of stents per lesion, mm	1.43±0.73	1.44±0.72	1.55±0.81	1.48±0.76	1.62±0.82
Total stent length per patient, mm	44.14±30.16	44.81±28.74	44.21±27.30	46.14±30.99	54.19±31.46
Total stent length per vessel, mm	38.87±24.62	39.70±24.04	44.30±27.69	40.55±25.23	47.68±26.25
Mean stent length, mm	27.25±10.64	27.56±10.92	27.73±10.22	27.84±10.71	30.43±10.70
Mean stent diameter, mm	3.16±0.55	3.15±0.54	3.13±0.54	3.17±0.55	3.16±0.55
Device success	2189/2230 (98.2%)	470 (95.7%)	275 (93.9%)	1792 (97.8%)	1109 (97.4%)
Procedural success	1792/1835 (97.7%)	393 (97.3%)	267 (98.5%)	1503 (97.5%)	964 (97.9%)

Data are mean (SD), n (%) or n/n (%) in case of missing data.

Table 4 Clinical outcomes at 30 days and 12 months follow-up

	30 days follow-up					12 months follow-up				
	Total (n=1835)	Diabetes (n=404)	Bifurcation (n=271)	Lesion B2/C (n=1541)	Long lesion (>20 mm) (n=985)	Total (n=1835)	Diabetes (n=404)	Bifurcation (n=271)	Lesion B2/C (n=1541)	Long lesion (>20 mm) (n=985)
TLF	12 (0.7%)	6 (1.5%)	1 (0.4%)	10 (0.6%)	6 (0.6%)	43 (2.3%)	25 (6.2%)	5 (1.8%)	38 (2.5%)	27 (2.7%)
Target vessel failure	12 (0.7%)	6 (1.5%)	1 (0.4%)	10 (0.6%)	6 (0.6%)	48 (2.6%)	26 (6.4%)	7 (2.6%)	43 (2.8%)	30 (3.0%)
Death from any cause	6 (0.3%)	2 (0.5%)	1 (0.4%)	6 (0.4%)	4 (0.4%)	34 (1.9%)	16 (4.0%)	4 (1.5%)	29 (1.9%)	21 (2.1%)
Cardiac death	5 (0.3%)	2 (0.5%)	1 (0.4%)	5 (0.3%)	4 (0.4%)	14 (0.8%)	9 (2.2%)	1 (0.4%)	13 (0.8%)	10 (1.0%)
All MI	10 (0.5%)	4 (1.0%)	0 (0.0%)	8 (0.5%)	4 (0.4%)	31 (1.7%)	13 (3.2%)	3 (1.1%)	27 (1.8%)	18 (1.8%)
TV-MI	4 (0.2%)	3 (0.7%)	0 (0.0%)	3 (0.2%)	1 (0.1%)	14 (0.8%)	9 (2.2%)	0 (0.0%)	12 (0.8%)	8 (0.8%)
Non-TV MI	6 (0.3%)	1 (0.2%)	0 (0.0%)	5 (0.3%)	3 (0.3%)	17 (0.9%)	4 (1.0%)	3 (1.1%)	15 (1.0%)	10 (1.0%)
TLR	4 (0.2%)	2 (0.5%)	0 (0.0%)	3 (0.2%)	1 (0.1%)	25 (1.4%)	11 (2.7%)	6 (2.2%)	23 (1.5%)	15 (1.5%)
CI-TLR	3 (0.2%)	1 (0.2%)	0 (0.0%)	2 (0.1%)	1 (0.1%)	15 (0.8%)	7 (1.7%)	4 (1.5%)	13 (0.8%)	9 (0.9%)
Non-CI TLR	1 (0.1%)	1 (0.2%)	0 (0.0%)	1 (0.1%)	0 (0.0%)	10 (0.5%)	4 (1.0%)	2 (0.7%)	10 (0.6%)	6 (0.6%)
TVR	4 (0.2%)	2 (0.5%)	0 (0.0%)	3 (0.2%)	1 (0.1%)	34 (1.9%)	13 (3.2%)	8 (3.0%)	32 (2.1%)	20 (2.0%)
CI-TVR	3 (0.2%)	1 (0.2%)	0 (0.0%)	2 (0.1%)	1 (0.1%)	20 (1.1%)	8 (2.0%)	6 (2.2%)	18 (1.2%)	12 (1.2%)
Non-CI TVR	1 (0.1%)	1 (0.2%)	0 (0.0%)	1 (0.1%)	0 (0.0%)	14 (0.8%)	5 (1.2%)	2 (0.7%)	14 (0.9%)	8 (0.8%)
Non-target vessel revascularisation	8 (0.4%)	2 (0.5%)	0 (0.0%)	7 (0.5%)	4 (0.4%)	43 (2.3%)	11 (2.7%)	2 (0.7%)	40 (2.6%)	31 (3.1%)
Postprocedure occlusion	1 (0.1%)	1 (0.2%)	0 (0.0%)	1 (0.1%)	0 (0.0%)	3 (0.2%)	3 (0.7%)	0 (0.0%)	3 (0.2%)	2 (0.2%)
Bleeding and vascular event	24 (1.3%)	6 (1.5%)	3 (1.1%)	22 (1.4%)	14 (1.4%)	43 (2.3%)	14 (3.5%)	5 (1.8%)	36 (2.3%)	23 (2.3%)
Any stent thrombosis	2 (0.1%)	1 (0.2%)	0 (0.0%)	1 (0.1%)	1 (0.1%)	6 (0.3%)	4 (1.0%)	0 (0.0%)	4 (0.3%)	3 (0.3%)
Definite stent thrombosis	2 (0.1%)	1 (0.2%)	0 (0.0%)	1 (0.1%)	1 (0.1%)	6 (0.3%)	4 (1.0%)	0 (0.0%)	4 (0.3%)	3 (0.3%)
Acute (0–1 days)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
Subacute (2–30 days)	2 (0.1%)	1 (0.2%)	0 (0.0%)	1 (0.1%)	1 (0.1%)	2 (0.1%)	1 (0.2%)	0 (0.0%)	1 (0.1%)	1 (0.1%)
Late (31–360 days)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	4 (0.2%)	3 (0.7%)	0 (0.0%)	3 (0.2%)	2 (0.2%)
Probable stent thrombosis	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)

Data expressed as frequency (percentages).
CI-TLR, clinically indicated target vessel revascularization; CI-TVR, clinically indicated target vessel revascularisation; MI, myocardial infarction; TLF, target lesion failure; TLR, target lesion revascularisation; TV-MI, target vessel myocardial infarction.

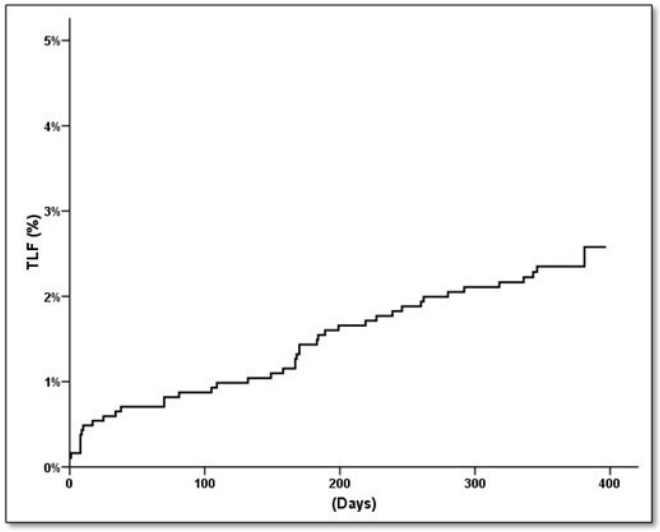

Figure 1 Kaplan-Meier curve showing target lesion failure (TLF) up to 12 months follow-up in overall population.

strut coverage and reduced neointimal proliferation and thrombogenicity.[10 11]

The findings in this current registry are in line with the S-FLEX UK registry (466 patients) which reported a low TLF rate at 2.4% with Supraflex SES, a predecessor of Supraflex Cruz SES.[12] Two real-world registries from India reported higher TLF rates of 3.8% and 5.75% with the Supraflex family of stents at 12 months follow-up.[5 6] However, it is important to consider that these varying outcomes may be influenced by variations among the patient populations being studied with a higher proportion of patients with diabetes mellitus seen in the Indian population. Additionally, the relatively low TLF rate observed in the present registry might be attributed to a higher frequency of lesion predilatation (91.2%) before stenting and higher rate of postdilatation (84.3%).

Incomplete strut coverage and inadequate, delayed endothelialisation are strongly associated with the incidence of late stent thrombosis. The strut thickness is the primary determining factor for the duration of strut coverage poststent implantation, with thinner struts potentially facilitating endothelial coverage and reducing risk of platelet aggregation.[13 14] The SiBi and TAXCO studies assessed strut apposition and tissue endothelialisation of the ultrathin Supraflex Cruz SES using OCT.[3 4] The SiBi study reported an average of 91.26% strut coverage at 35.3±5 days[4] and the TAXCO study revealed 97.6% stent coverage at 6 months post-PCI with Supraflex Cruz SES, a rate comparable to that of the Xience everolimus-eluting stent.[3] These findings collectively suggest low inflammation and early optimal healing response with Supraflex Cruz SES and give mechanistic insight into the safety endpoints seen both in our registry and in those reported by others.[5 6 15 16]

The device success rate was high and may be attributable to design changes in the newer generation Supraflex Cruz SES. It is an ultrathin cobalt-chromium platform with unique alternate LDZ links from valley-to-valley which has been developed with an aim to treat complex coronary lesions in high-risk patients. The delivery mechanism has a softer balloon for stent retention and retrieval after deployment, and a redesigned proximal shaft to enhance crossability compared with its predecessor.

The results of the current S-FLEX UK-II registry confirm class leading safety and efficacy with low rates of TLF and stent thrombosis in patients with high-risk clinical and anatomical characteristics. Further evidence of safety and efficacy of this platform was reported in the Cruz-HBR registry demonstrating superior outcomes in PCI compared with the biolimus-drug coated stent for high-risk bleeding (HBR) patients.[17] In the recently published FIRE trial (2023), it was observed that in elderly patients (≥75 years) with MI and multivessel CAD, adopting a physiology-guided complete revascularisation using Supraflex Cruz SES was associated with a significantly reduced risk when compared with culprit-only revascularisation.[18] The findings from the current S-FLEX UK-II registry add further evidence for the safety and effectiveness of the ultrathin Supraflex Cruz SES in an all-comer population in the UK.

The present registry has certain limitations. The study was non-randomised and lacked a direct comparator. Also, the coronary lesions were evaluated through visual estimation and no angiographic core lab assessment and intracoronary imaging modalities were used. The follow-up was conducted for up to 12 months with data beyond this time point not collected. All events were recorded directly from patients and their medical notes with no adjudication.

Conclusion

The S-FLEX UK-II registry provides further evidence on the clinical safety and performance of Supraflex Cruz SES in all-comer patients population with CAD in the UK. The results reinforce both safety and performance of the Supraflex Cruz SES, with clinically low rates of TLF and stent thrombosis at 12 months, even among complex subgroups, with diabetes mellitus, bifurcation lesions, type B2/C lesions and long coronary lesions (>20 mm).

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Patient consent for publication Not applicable.

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