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Letter to the Editor

Simplifying the double kissing (DK) crush with the use of bioresorbable scaffolds

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A 70 year old gentleman presented with exertional breathlessness on a background of treated hypertension. Transthoracic echocardiography demonstrated mild aortic regurgitation and a dilated left ventricle (LV) with severely impaired systolic function (ejection fraction 30%). His anterior and anteroseptal walls were hypokinetic, albeit viable. His right ventricle was normal in size and function. His estimated pulmonary pressures were elevated at 45 mm Hg. A diagnostic coronary angiogram revealed (i) distal left main 0,1,0 bifurcation disease, (ii) a heavily calcific proximal true bifurcation LAD lesion (1,1,1) involving the first diagonal, (iii) an aneurysm at the LAD, immediately distally to the LAD-D1 bifurcation and (iv) diffuse significant disease extending from the proximal to the mid-distal LAD with competitive flow distally (Fig. 1). His right coronary artery was ectatic with atheroma and was collateralizing the distal LAD. In view of the viability of the anterior and lateral walls, and the presence of exertional symptoms, a decision was made to revascularize the patient. Since the LAD had diffuse disease extending to the distal vessel, the Heart team opted for percutaneous revascularization using bioresorbable vascular scaffolds. The LAD was pre-dilated initially with a semi-compliant 2.5 × 30 mm balloon and subsequently with non-compliant (NC) balloons from its ostium (NC 3.5mm to 16 atm) to its mid- (NC 3.0mm to 16 atm) and distal segments (NC 2.5mm to 14 atm). The diagonal ostial-proximal lesion was also predilated with a semi-compliant 2.5 × 30 mm balloon and an NC 2.5mm balloon to 14 atm. Kissing pre-dilatation was also performed with a 2.5 mm NC in the diagonal and a 3.5 mm NC in the LAD (Fig. 2). Subsequently the operators proceeded with the implantation of x2 Cre8 (Alvimedica, Milan, Italy) amphilimus eluting polymer-free stents in the diagonal (2.5 × 20 mm and 2.5 × 12 mm) using the double kissing (DK) crush technique [1]. The first kissing balloon inflation of the DK crush was performed using a 2.5 mm NC balloon in the diagonal and a 3.5 mm balloon in the LAD (Fig. 2). Intravascular ultrasound (IVUS) at that stage showed the crushed stents at the wall of the proximal LAD and distal LMS (Fig. 3A) and a widely open and strut-free diagonal ostium (Fig. 3B). Subsequently the operators implanted a full plastic jacket [2] with three Absorb (Abbott Vascular, Santa Clara, CA, USA) bioresorbable scaffolds (BVS) from the distal LMS (BVS 3.5 × 28mm to 12 atm) to the mid- (BVS 3.0 × 28 mm to 11 atm) and distal (BVS 2.5 × 28 mm to 10 atm) LAD (Fig. 4). The proximal scaffold was post-dilated with a 4.0 mm NC balloon to 18 atm, the mid with a 3.5 mm NC balloon to 20 atm and the distal with a 2.5 mm NC balloon to 24 atm. The second

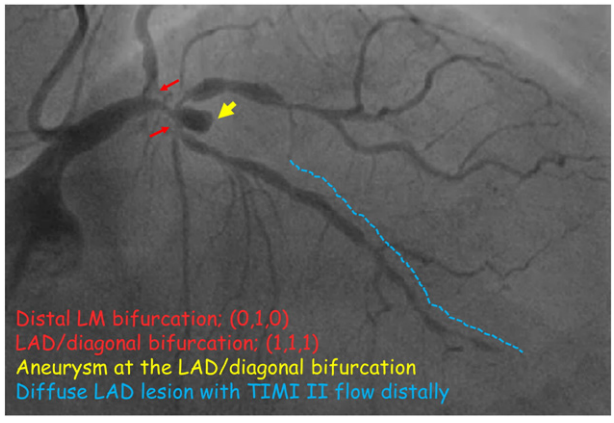

Fig. 1. Complex anatomy involving two bifurcations (left main and LAD-diagonal), a coronary aneurysm and diffuse mid-distal LAD disease.

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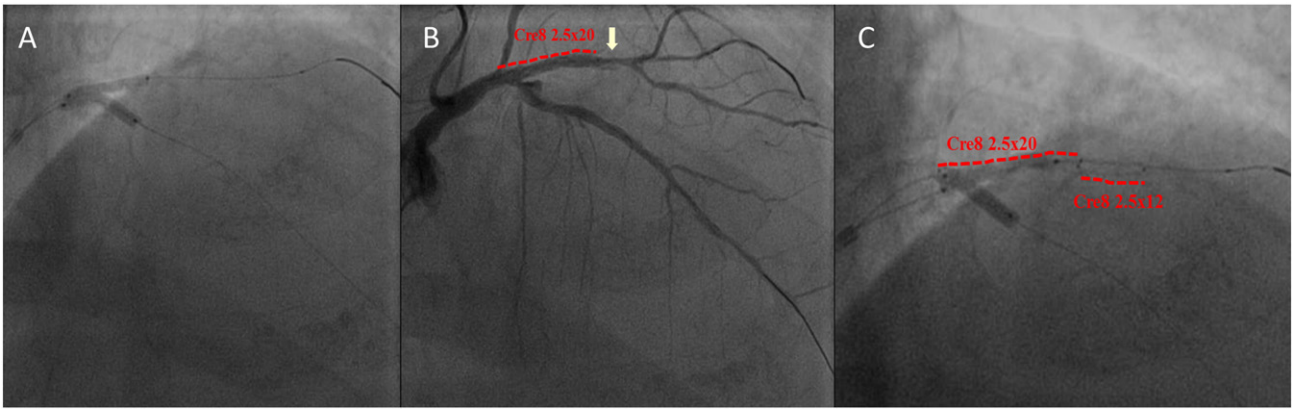

Fig. 2. Initial extensive lesion preparation with semi-compliant and non-compliant balloons in both LAD and diagonal followed by a low pressure (8 atm) kissing balloon inflation with non-compliant balloons (3.5 mm in LAD and 2.5 mm in diagonal) (A). Subsequent implantation of a Cre8 2.5 × 20 mm amphilimus eluting stent in the diagonal using the double kissing (DK) crush technique (B). The distal stent edge dissection was covered with another 2.5 × 12 mm Cre8 stent. After re-crossing the crushed struts with a new balance middleweight universal wire we performed the first kissing balloon inflation of the DK crush technique (C).

and final kissing (LAD-D1) of the DK crush bifurcation strategy was not performed as the bioresorbable struts jailing the diagonal ostium will eventually disappear in the following couple of years [3]. Final IVUS demonstrated an excellent result (Fig. 5). The patient was discharged on dual antiplatelet therapy (aspirin and clopidogrel) for one year and remains asymptomatic 12 months following the procedure. This case illustrates the use of a modified DK crush technique, using bioresorbable scaffolds for the main branch and new generation polymer free stents for the side branch, omitting the final kissing balloon inflation.

Despite the consensus that provisional technique should be the default strategy for bifurcation lesions, the two-stent techniques are still performed in patients with true bifurcations and significant diffuse side branch stenosis [4]. The DKCRUSH-II trial [5], which randomised 370 patients with a true bifurcation (Medina 1,1,1 or 0,1,1) to either DK crush or provisional T-stenting, showed a significantly lower rate of 1-year target lesion revascularisation (TLR) after DK crush (6.5% vs. 14.6%, $p = 0.017$). The potentially superior results of DK crush over simple crush for the treatment of true coronary bifurcations were first described in the randomised DKCrush-1 study ($N = 312$ patients) [1]. In this trial final kissing balloon inflation was achieved in only 76% of the crush group versus 100% in the DK crush one ($p < 0.001$). This translated to an 8-month cumulate major adverse cardiovascular event (MACE) rate of 24.4% in the classic crush versus 11.4% in the DK crush group ($p = 0.02$). Recently, the DKCRUSH-III study [6], including 419 patients with distal left main bifurcation lesions randomised to either culotte or DK crush stenting, showed that one-year clinical outcomes (MACE: DK 6.2% vs. culotte 16.3%, $p < 0.001$; TLR: DK 2.4% vs. culotte 6.7%, $p = 0.037$) and 13-month angiographic results (in-stent restenosis: DK 5.11% vs. culotte 10.9%, $p = 0.037$) were in favour of DK crush when compared with the culotte stenting technique. It seems therefore

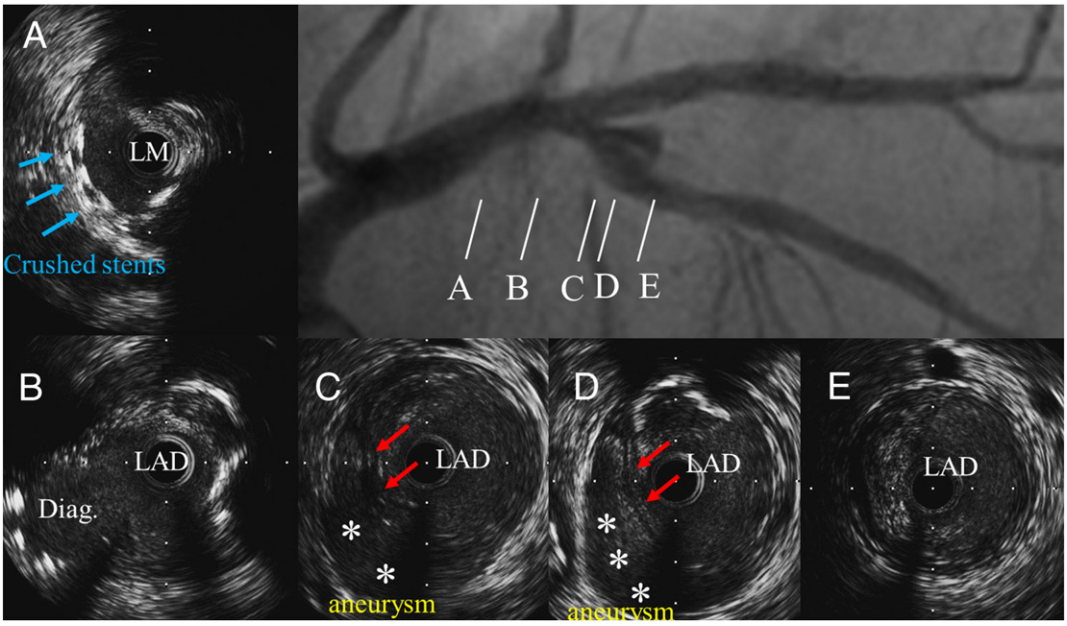

Fig. 3. Intravascular ultrasound after first kissing balloon inflation (KBI) of DK crush. (A) Crushed Cre8 stents can be seen protruding into the distal LMS. (B) The diagonal ostium is clear of stent struts after the first KBI of the DK crush. (C, D) The aneurysmal segment of the LAD is highlighted with an asterisk whereas the red arrows indicate folding of the intima media. (E) Good result in the midsegment after extensive pre-dilatation with non-compliant balloons.