



TECHNIQUE CROSSOVER IN STENTING CORONARY BIFURCATION

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SUMMARY – Planning and guiding PCI in a complex intervention is very important and one of the most important decisions is the one on whether to use one or two stent bifurcation techniques. Unfortunately, this can easily turn into complication and the need to alter the procedural strategy. The main points to be considered when deciding on the PCI strategy are related to both procedural safety and long-term outcomes. Provisional stenting has been recommended as the default technique for most coronary bifurcation lesions. In this paper, we describe the case of a patient scheduled for elective procedure of bifurcation lesion of LAD/D1. Our planned strategy was provisional stenting of LAD, using one stent for LAD, DCB for D1. Due to the complication that occurred, i.e., dissection of LAD after LAD stenting, we changed the strategy to two-stents technique strategy, using Culotte technique.

Key words: *Bifurcation lesions, bifurcation techniques, one-stent technique, two-stent technique, Culotte*

Introduction

Approximately 15-20° of percutaneous coronary interventions (PCI) are performed to treat coronary bifurcations lesions (CBL) and those procedures are recognised for being technically challenging and associated with lower procedural success rates and worse clinical outcomes compared with non-bifurcation lesions. (1)

Stenting of the side branch (SB) is clearly indicated in occasions of major SB dissections or compromised SB flow after final kissing inflation (FKI). However, the problem of residual stenosis is still controversial because angiographic assessment of the SB ostium is not easy. Selection of an appropriate strategy for individual bifurcation lesion and optimal procedural results lead to satisfactory early and long-term clinical outcome.

Although several stenting approaches for CBL have been proposed, recent randomized studies re-

vealed that planned dual-stenting techniques do not demonstrate clinical or angiographic superiority compared to a planned single stenting strategy, even in the era of the drug-eluting stents (DES). Based on these studies, crossover provisional single stenting has been generally accepted as a favoured strategy for CBL. (2)

Case presentation

77-year-old male patient was admitted to coronary care unit due to inferior acute ST segment myocardial infarction. He had no prior cardiovascular disease. Coronary angiography was performed immediately, which detected the dominant right coronary artery, occluded in the mid-segment. After predilatation with semicompliant balloon 2.5x15 mm/14 ATM, the implantation of DES was performed with a 3.0x35 mm stent, which restored TIMI III coronary grade flow.

Coronary angiography of the left coronary branches showed angiographically moderate stenosis of the left main, significant bifurcational stenosis of the mid-

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left anterior descending artery (LAD), and first diagonal branch (D1), Medina 0,1,1. (Fig 1.)

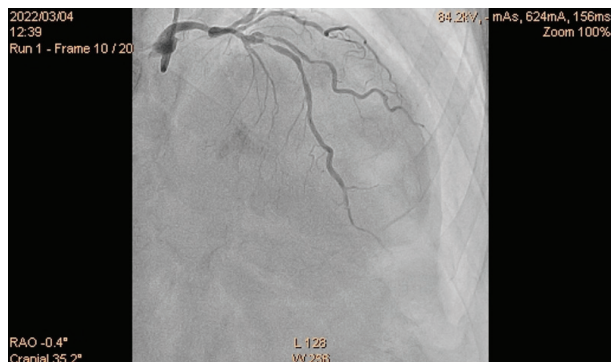


Fig 1. Moderate stenosis of the left main, but significant bifurcational stenosis of the mid-left anterior descending artery.

For optimal resolution of severity of distal LM intravascular, ultrasound (IVUS) was performed based on the same principles used for ultrasound elsewhere in the body. It utilises a monorail catheter with an ultrasound transducer at its tip to generate a two-dimensional cross-sectional image of the coronary artery similar to a histologic cross section. (1)

IVUS showed dominantly fibrotic plaque in mid-portion of LAD with a minimal lumen area (MLA) distally from bifurcation with the first diagonal branch of 1.95 mm² (Fig 2).

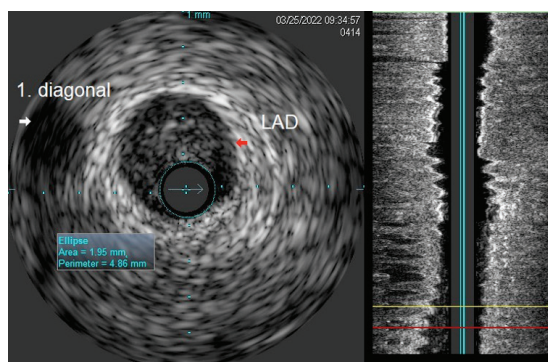


Fig 2. Intravascular ultrasound of LAD stenosis

Distal left main in intravascular ultrasonography showed a dominantly fibrotic plaque with a small amount of calcification and MLA of 9.38 mm², a non-significant lesion (Fig 3).

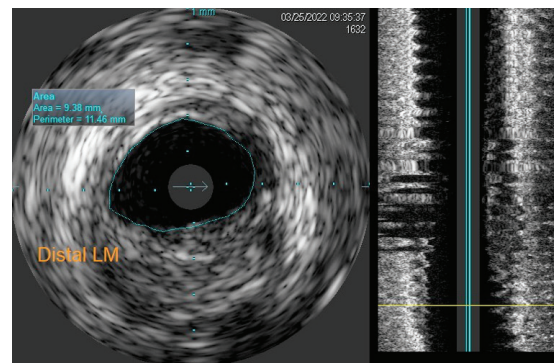


Fig 3. Intravascular ultrasound of distal left main

On IVUS, we found an optimal landing zone in proximal LAD with MLA of 5.69mm² and less than 50% of plaque burden. By expert analyses from Gary S Mintz, IVUS and PCI guidance, the optimal landing zones are the largest lumens with the smallest plaque burden ideally < 50% (3) Fig 4.

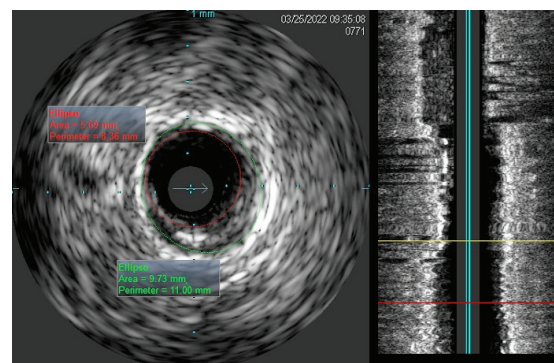


Fig 4. Intravascular ultrasound of proximal LAD – protentional landing zone

These IVUS measurements provided us with plenty of information and resolved our search for the optimal stent diameter needed.

After wiring of LAD and D1, predilatation of each severe stenosis was performed. DCB of 2.75x25 mm/6 atm/1 min was placed in D1, and afterwards DES 3.0x18 mm/12 ATM was performed in LAD, using a provisional technique.

Suddenly, the patient developed severe chest pain with a drop in arterial pressure, and malignant arrhythmia. He was urgently defibrillated with 200 J, which restored the sinus rhythm. The patient was conscious but had severe chest pain. Angiography showed LAD dissection proximally from the posi-

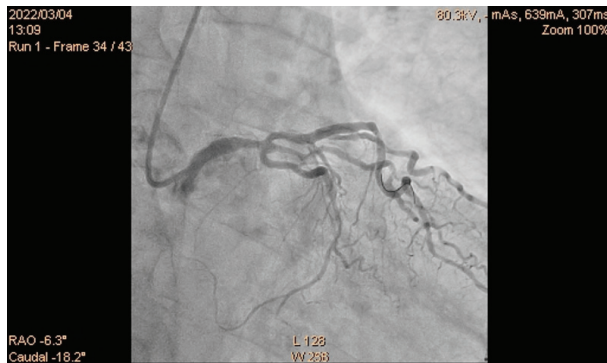


Fig 5. LAD dissection proximally from the positioned stent.

tioned stent, which we believe to be the cause of ventricular fibrillation.

At that point, we decided to use control IVUS imaging. It revealed dissection of LAD proximally from the positioned stent (Fig 6).

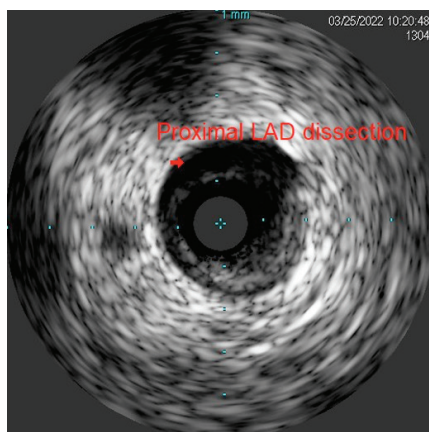


Fig 6. Dissection of LAD proximally from the positioned stent

Angiography revealed a coronary dissection type C according to the National Heart, Lung and Blood Institute classification system (NHLBI). D1 branch also had an suboptimal angiography result with > 30% residual stenosis after DCB.

This finding changed our strategy and the provisional stenting technique was replaced with a two-stent technique. DE stent 2,75x33/12 ATM was positioned from substial LAD into D1, in the Culotte technique manner with all the required steps (POT, kiss and rePOT with associated balloons). Finally, we got an optimal angiographic result of the stented segment in both branches, LAD and D1, covering both

the ostial lesion of D1 and the proximal dissection of LAD, with TIMI III coronary grade flow.

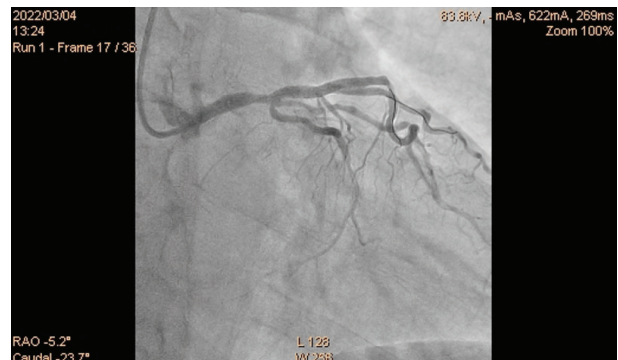


Fig 7. Optimal angiographic result of the stented segment in both branches, LAD and D1, covering both the ostial lesion of D1 and the proximal dissection of LAD, with TIMI III coronary grade flow.

Patient was stabilised, no longer felt chest pain, and had a normal blood pressure without arrhythmias.

Discussion

Considering the bifurcation stenosis Medina 0,1,1, we decided that the provisional technique with DE balloon in D1 branch, and DE stent in LAD, could be the optimal solution in comparison with a much complex scenario of two-stent techniques.

Unfortunately, this can easily turn into complication and the need to alter the procedural strategy.

Recent meta-analysis showed that two-stent techniques using DK-Crush provide the best outcomes if the side branch (SB) lesion length is ≥ 10 mm. (4) Provisional stenting was recommended as the default technique for most coronary bifurcation lesions. The aim of this study was to compare clinical outcomes of different bifurcation percutaneous coronary intervention (PCI) techniques by means of a network meta-analysis. Twenty-one randomized controlled trials we performed including 5,711 patients treated with 5 bifurcation PCI techniques (provisional, crush, culotte, T stenting/T and protrusion, and double-kissing crush).

After a median follow-up period of 12 months (interquartile range: 9 to 36 months), the double-kissing crush technique had less occurrence of major adverse cardiovascular events (odds ratio: 0.39; 95% credible interval: 0.26 to 0.55) compared with the provisional stenting. This difference was driven by a reduction in

target lesion revascularization (odds ratio: 0.36; 95% credible interval: 0.22 to 0.57). No differences were found in cardiac death, myocardial infarction, and stent thrombosis in the analysed PCI techniques.

However, leading with EBC consensus regarding elective two-stent strategies, bifurcated lesion with extensive atherosclerotic involvement of both the main branch (MB) and the important side branch (SB), the strategy depends on the risk of losing the SB after MB stenting. (5) If the risk of losing the SB after MB stenting is low, the optimal strategy is MB stenting across the SB with the provisional strategy (using T-stent, Tap, or Culotte). If the major concerns regarding the SB after MB stenting exist, the optimal strategy is DK-Crush or inverted provisional strategy.

Another very important issue to discuss is the risk of MACE with coronary artery dissection, which results in the need for stenting. Coronary artery dissections were categorized in class A-F type by the Na-

tional Heart, Lung and Blood Institute classification system (6).

The answer to the question which technique to use in this situation can be found in the MADS classification - possibilities for bifurcation stenting after positioning one stent in the proximal main vessel (7) (Fig 8).

In our case, we were not able to finish just by ballooning the SB due to disproportion in the diameter of two daughter vessels. The possibilities that the MADS classification provided, after positioning a stent in the main branch, were internal crush, TAP and an elective T stent. Both TAP and T stenting require an angulation between vessels >70%. In our case, the angulation was < 70%. Internal crush, on the other hand gives crushing stent struts, which can lead to the risk of stent thrombosis within the bifurcation. However, the Culotte technique endures the narrow bifurcation angulation but requires an equal bifurcation vessel di-

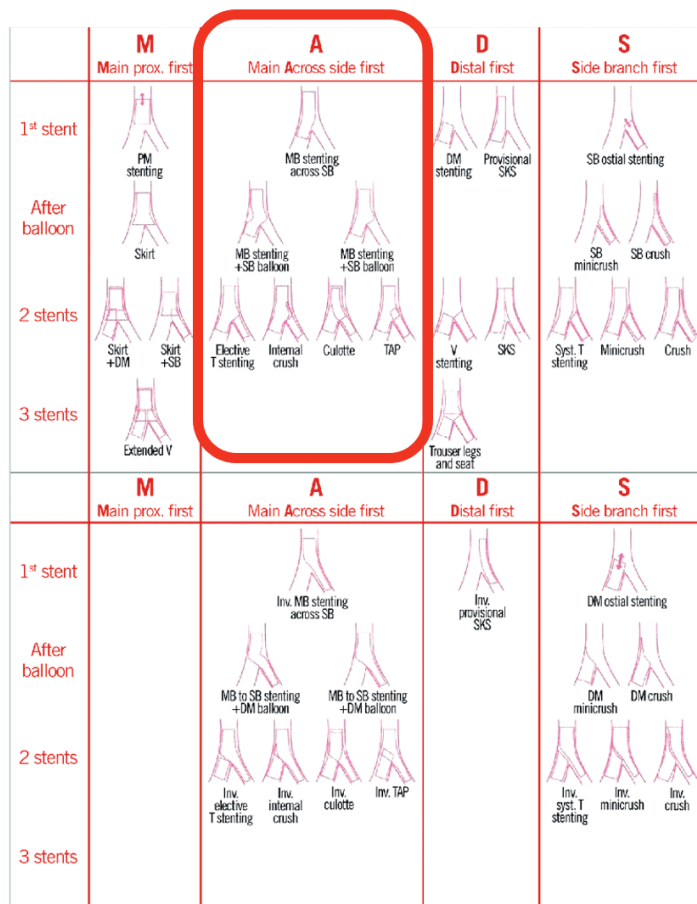


Figure 8. The MADS classification is a systematic description of bifurcation stenting techniques grouped in families.

ameter. We needed a stent that could be optimized proximally to the proximal vessel size.

Another point to be considered was the risk of restenosis with Culotte stenting, especially in comparison to other two-stent techniques. A pilot study on Culottes versus crossover single stenting for true coronary bifurcation lesions compared two different approaches for the treatment of true CBL in a randomized fashion and included the following: (1) crossover provisional single stenting with DES placement in the main branch (MB) with SB stenting only if final results were found to be suboptimal (TIMI \leq 1 flow), and (2) Culottes technique with DES in both branches of the CBL (8). This study demonstrated that there were no significant differences in cumulative MACE and in-segment restenosis between the crossover and culotte groups in the treatment of true bifurcation lesions. Both crossover stenting and culotte stenting provided promising clinical and angiographic outcomes. Larger randomized trials are warranted to further re-evaluate these two techniques utilizing DES for treatment of true CBL.

BBK II trial (9) published in 2016 found that the Culotte stenting technique had significantly lower incidence of angiographic restenosis in comparison to "TAP stenting". Another trial found no difference between the Culotte stenting technique and the crush technique regarding the incidence of clinical and angiographic outcomes (10), but with lower percentage of FKB. Finally, DK-CRUSH III trial found significantly a lower rate of MACE with DKCRUSH technique in comparison to the Culotte technique (11), but these inferior results have been found in interventions on the left main disease. Our opinion is that the best results can only be achieved with completing every step of the specified technique

Conclusion

A choice of an appropriate stent technique in bifurcation lesions depends on individual patient's anatomical characteristics and the operator's skills. Elective two-stent techniques may be considered for important SB with complex/extensive stenoses, difficult SB access or high risk of SB compromise.

Another important issue is the risk of MACE with coronary artery dissection, which creates the need for stenting. Iatrogenic coronary artery dissections are categorized according to the NHLB Institute classification system (type A- F).

In the scenario where the dissection should be stented, it is possible to use the MADS classification to decide which bifurcation technique, after positioning the first stent in the proximal main vessel, is the most appropriate for a particular case.

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Sažetak

PROMJENA BIFURKACIJSKE TEHNIKE PRI STENTIRANJU KORONARNIH ARTERIJA

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Planiranje i vođenje kompleksnih PCI intervencija vrlo je važno, a jedna od tih odluka je i odluka hoće li se koristiti tehnika stentiranja jednim ili tehnike stentiranja dva stenta.

Nažalost, to se lako može pretvoriti u komplikaciju potrebe za promjenom proceduralne strategije.

Glavne točke koje treba uzeti u obzir pri odlučivanju o PCI strategiji nisu samo sigurnost postupka nego i dugoročni rezultati. Provisional strategija stentiranja se preporučuje kao zadana tehnika za većinu koronarnih bifurkacijskih lezija.

U ovom prikazu slučaja prikazujemo bolesnika predviđenog za elektivni zahvat bifurkacijske lezije LAD/D1. Planirana strategija bila je Provisional stentiranje LAD-a, s plasiranjem jednog stenta u LAD, DC balona u D1. Zbog komplikacije koja je nastala, razvoja disekcije nakon postavljanja stenta u glavnu žilu, promijenili smo strategiju na strategiju s dva stenta tehnikom; Culotte tehnikom.

Ključne riječi: *Bifurkacijske lezije, tehnike bifurkacije, tehnika jednog stenta, tehnika s dva stenta, Culotte*