

Left main PCI: are we giving the kiss the attention it deserves?



Goran Stankovic^{1,2*}, MD, PhD; Dejan Milasinovic^{1,2}, MD; Zlatko Mehmedbegovic^{1,2}, MD

1. Department of Cardiology, Clinical Center of Serbia, Belgrade, Serbia; 2. Faculty of Medicine, University of Belgrade, Belgrade, Serbia

The goal of coronary bifurcation percutaneous coronary intervention (PCI) is optimal stent deployment/apposition, aimed at restoring natural fractal vessel geometry and blood flow pattern. Among different optimisation strategies, the proximal optimisation technique (POT) is recommended by expert consensus as a mandatory procedural step, while the use of kissing balloon inflation (KBI) has shown consistent clinical benefit and should be obligatory in two-stent strategies, whilst it remains optional in provisional side branch (SB) stenting due to conflicting evidence (Table 1).

In this issue of EuroIntervention, Kini et al¹ present a sub-analysis of the EXCEL trial (Evaluation of XIENCE Versus Coronary Artery Bypass Surgery for Effectiveness of Left Main Revascularisation), which investigated the impact of final KBI in 759 patients undergoing distal left main (LM) bifurcation stenting, 430 of whom were treated with one stent and 329 with ≥ 2 stents.

Article, see page 218

The main findings were that the four-year composite of death, myocardial infarction (MI) or stroke was similar with and without final KBI in both patients treated with one stent (17.5% vs 15.9%, respectively; adjusted HR 1.12, 95% CI: 0.68-1.84, $p=0.65$) and

those treated with ≥ 2 stents (19.8% vs 25.8%; adjusted HR 0.65, 95% CI: 0.38-1.10, $p=0.11$). There was also no difference in the target lesion revascularisation (TLR) rates. Although KBI did increase the overall procedural and fluoroscopy time, this was not paralleled by an increase in radiation exposure or contrast volume, nor were there more periprocedural complications (including periprocedural MI) reported. Therefore, in this EXCEL sub-analysis, performing KBI did not improve outcomes of LM PCI, but there was also no penalty attached. While this was expected in patients treated with one stent, given the prior evidence, the absence of outcome improvement with KBI in patients treated with two-stent bifurcation PCI may be surprising^{2,3}.

Therefore, and notwithstanding the main limitations of this secondary analysis, namely its non-randomised design with possible selection bias, and the lack of a standardised protocol for the use of final KBI, the following additional points may also need to be taken into consideration when interpreting the overall results.

First, the subgroup of patients with ≥ 2 stents implanted was heterogenous with respect to both the intention to perform two-stent PCI (planned versus bail-out) and to the stenting technique

*Corresponding author: Department of Cardiology, Clinical Center of Serbia, 26 Visegradska, 11000 Belgrade, Serbia.
E-mail: gorastan@sbb.rs

Table 1. Studies evaluating clinical effects of kissing balloon inflation in coronary bifurcation stenting.

Study or first author	Study design	Population				% Cardiac death KBI vs no KBI	% Myocardial infarction KBI vs no KBI	% TLR KBI vs no KBI	% MACE KBI vs no KBI	
		Number of patients	% Left main	KBI (N)	Follow-up months					
Provisional SB stenting strategy										
↑	COBIS II ⁵	Registry	1,901	25.9	620	36	0.6 vs 1.2	0.6 vs 1.8	5.8 vs 6.6	6.8 vs 8.6*
↔	NORDIC III ⁷	RCT	477	8.0	238	6	0.8 vs 0.0	0.4 vs 1.3	1.3 vs 1.7	2.1 vs 2.5
↔	AOI-LMCA ⁸	Registry	738	100	578	48	6.3 vs 9.1	2.6 vs 6.4	10.7 vs 14.3	17.0 vs 21.3
↔	RAIN - CARDIOGROUP VII ²	Registry	2,099	NA [▲]	755	16	6.1 vs 6.6 [◊]	7.3 vs 5.3	5.3 vs 3.2	15.0 vs 12.4
↓	COBIS I ⁹	Registry	1,065	0	736	22	0.9 vs 0.7	0.6 vs 1.3	9.1 vs 3.4*	10.0 vs 4.9*
2-stent strategy										
↑	Ge et al ³	Observational	181	26.5	116	9	1.7 vs 0.0	10.3 vs 13.9	9.5 vs 24.6*	19.8 vs 38.5*
↑	Grundeken et al ¹⁰	Registry	745	5.6	624	6	1.7 vs 4.6*	5.0 vs 4.6	4.7 vs 2.9	NA
↑	RAIN - CARDIOGROUP VII ²	Registry	439	NA [▲]	321	16	6.6 vs 3.9 [◊]	5.6 vs 6.0	7.3 vs 15.2*	16.6 vs 24.9

Green, yellow and red arrows denote respectively the positive, neutral and negative direction of the study results in terms of the ability of KBI to improve clinical outcomes. * $p < 0.05$. [▲]26.7% in the overall RAIN-GROUP VII population that included 2,742 patients. [◊]All-cause death. KBI: kissing balloon inflation; RCT: randomised controlled trial; SB: side branch

(T/TAP versus Culotte versus Crush versus V/simultaneous kissing stent [SKS]). Moreover, the majority of patients with ≥ 2 stents implanted but without final KBI were initially subjected to a provisional strategy (60%), and almost all were ultimately treated with the T or TAP technique (only five patients were treated with other two-stent techniques in the non-final KBI group). This heterogeneity appears not to have been accounted for in the analysis.

Second, no specific details are provided with regard to the technique of KBI used in the trial. Since prior studies associated the use of non-compliant balloons with sequential balloon inflation⁴ and short proximal overlap² with improved outcomes⁵, these variables could potentially be effect modifiers and would need to be considered in the overall analysis.

Third, bifurcation stenting optimisation has increasingly been understood as a concept of adapting stent geometry to the underlying bifurcation anatomy. This is particularly relevant in bifurcations with a large side branch (SB), where there is a greater discrepancy between the proximal and distal main vessel (MV) diameters, such as the LM, so that stenting optimisation may go beyond a single technique, such as KBI. When stent size is selected according to distal MV reference, performance of POT is mandatory to correct malapposition and distortion in the proximal part of the MV⁴. The advantage of KBI, in addition to better stent expansion in the proximal MV, is relocation of the carina in the centre, with an improvement in wall shear stress pattern⁴. However, the effect of the interaction of POT and KBI on the procedural result and clinical outcomes has not been well established. Consequently, the rate of POT, which seems not to be specifically reported in the manuscript, may have significantly impacted on the result of KBI and the outcomes in both patients with one and in those with ≥ 2 stents implanted in the LM.

Fourth, even though intravascular ultrasound (IVUS) was used in $\approx 80\%$ of the cases, it is not reported whether there was any

standardised protocol mandating action in terms of immediate post-stenting result optimisation. This is important since a recent study confirmed the primacy of a standardised protocol over non-standard IVUS protocols for improving outcomes of LM PCI⁶.

In summary, this and prior studies (**Table 1**) seem to suggest no clear penalty associated with performing KBI, whereas its potential benefits may depend on a specific stenting technique (one- versus two-stent), underlying anatomy, complementary use of other optimisation techniques, such as POT, and a procedural feedback loop that is based on an actionable standardised intracoronary imaging protocol⁶. Taken together, it thus seems to be a question of when and how, rather than if, KBI should be performed in LM PCI.

Conflict of interest statement

The authors have no conflicts of interest to declare.

References

- Kini AS, Dangas GD, Baber U, Vengrenyuk Y, Kandzari DE, Leon MB, Morice MC, Serruys PW, Kappetein AP, Sabik JF 3rd, Dressler O, Mehran R, Sharma SK, Stone GW. Influence of final kissing balloon inflation on long-term outcomes after PCI of distal left main bifurcation lesions in the EXCEL trial. *EuroIntervention*. 2020;16:218-24.
- Gaido L, D'Ascenzo F, Imori Y, Wojakowski W, Saglietto A, Figini F, Mattesini A, Trabattini D, Rognoni A, Tomassini F, Bernardi A, Ryan N, Muscoli S, Helft G, De Filippo O, Parma R, De Luca L, Ugo F, Cerrato E, Montefusco A, Pennacchi M, Wanha W, Smolka G, de Lio G, Bruno F, Huczek Z, Boccuzzi G, Cortese B, Capodanno D, Omede P, Mancone M, Nunez-Gil I, Romeo F, Varbella F, Rinaldi M, Escaned J, Conrotto F, Burzotta F, Chieffo A, Perl L, D'Amico M, di Mario C, Sheiban I, Gagnor A, Giammaria M, De Ferrari GM. Impact of Kissing Balloon in Patients Treated With Ultrathin Stents for Left Main Lesions and Bifurcations: An Analysis From the RAIN-CARDIOGROUP VII Study. *Circ Cardiovasc Interv*. 2020;13:e008325.
- Ge L, Airoldi F, Iakovou I, Cosgrave J, Micev I, Sangiorgi GM, Montorfano M, Chieffo A, Carlino M, Corvaja N, Colombo A. Clinical and

- angiographic outcome after implantation of drug-eluting stents in bifurcation lesions with the crush stent technique: importance of final kissing balloon post-dilatation. *J Am Coll Cardiol*. 2005;46:613-20.
4. Murasato Y, Finet G, Foin N. Final kissing balloon inflation: the whole story. *EuroIntervention*. 2015;11 Suppl V:V81-5.
 5. Yu CW, Yang JH, Song YB, Hahn JY, Choi SH, Choi JH, Lee HJ, Oh JH, Koo BK, Rha SW, Jeong JO, Jeong MH, Yoon JH, Jang Y, Tahk SJ, Kim HS, Gwon HC. Long-Term Clinical Outcomes of Final Kissing Ballooning in Coronary Bifurcation Lesions Treated With the 1-Stent Technique: Results From the COBIS II Registry (Korean Coronary Bifurcation Stenting Registry). *JACC Cardiovasc Interv*. 2015;8:1297-307.
 6. de la Torre Hernandez JM, Garcia Camarero T, Baz Alonso JA, Gomez-Hospital JA, Veiga Fernandez G, Lee Hwang DH, Sainz Laso F, Sanchez-Recalde A, Perez de Prado A, Lozano I, Hernandez Hernandez F, Gonzalez Lizarbe S, Gutierrez Alonso L, Zueco J, Alfonso F. Outcomes of predefined optimisation criteria for intravascular ultrasound guidance of left main stenting. *EuroIntervention*. 2020;16:210-7.
 7. Niemelä M, Kervinen K, Erglis A, Holm NR, Maeng M, Christiansen EH, Kumsars I, Jegere S, Dombrovskis A, Gunnes P, Stavnes S, Steigen TK, Trovik T, Eskola M, Vikman S, Romppanen H, Mäkikallio T, Hansen KN, Thayssen P, Aberg L, Jensen LO, Hervold A, Airaksinen J, Pietilä M, Frobert O, Kellerth T, Ravkilde J, Aaroe J, Jensen JS, Helqvist S, Sjogren I, James S, Miettinen H, Lassen JF, Thuesen L; Nordic-Baltic PCI Study Group. Randomized comparison of final kissing balloon dilatation versus no final kissing balloon dilatation in patients with coronary bifurcation lesions treated with main vessel stenting: the Nordic-Baltic Bifurcation Study III. *Circulation*. 2011;123:79-86.
 8. Nishida K, Toyofuku M, Morimoto T, Ohya M, Fuku Y, Higami H, Yamaji K, Muranishi H, Yamaji Y, Furukawa D, Tada T, Ko E, Kadota K, Ando K, Sakamoto H, Tamura T, Kawai K, Kimura T; AOI LMCA Stenting Registry Investigators. Prognostic impact of final kissing balloon technique after crossover stenting for the left main coronary artery: from the AOI-LMCA registry. *Cardiovasc Interv Ther*. 2019;34:197-206.
 9. Gwon HC, Hahn JY, Koo BK, Song YB, Choi SH, Choi JH, Lee SH, Jeong MH, Kim HS, Seong IW, Yang JY, Rha SW, Jang Y, Yoon JH, Tahk SJ, Seung KB, Park SJ. Final kissing ballooning and long-term clinical outcomes in coronary bifurcation lesions treated with 1-stent technique: results from the COBIS registry. *Heart*. 2012;98:225-31.
 10. Grundeken MJ, Lesiak M, Asgedom S, Garcia E, Bethencourt A, Norell MS, Damman P, Woudstra P, Koch KT, Vis MM, Henriques JP, Tijssen JG, Onuma Y, Foley DP, Bartorelli AL, Stella PR, de Winter RJ, Wykrzykowska JJ. Clinical outcomes after final kissing balloon inflation compared with no final kissing balloon inflation in bifurcation lesions treated with a dedicated coronary bifurcation stent. *Heart*. 2014;100:479-86.