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Original Article

POT-side-POT vs KBI: Finding the Balance in Bifurcation PCI

Ahmad Alabrass[1], Eyas Al Khayer[2], Akram Jahjah[3]

[1,2,3]*Department of Internal Medicine, Faculty of Medicine, Latakia University, Syria.*

[1]*Corresponding Author : ahmad.q.alabras@latakia-univ.edu.sy*

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Abstract *- Background: There are still technical challenges related to the treatment of Coronary Bifurcation Lesions (CBLs) during Percutaneous Coronary Interventions (PCI) owing to the complex morphology of the arteries and the potential risk of Side Branch (SB) loss. There have been ongoing discussions on the optimal approach in SB optimization, whether the Kissing Balloon Inflation (KBI) technique or the Proximal Optimization Technique with side sequential inflation (POT-side-POT) technique. Objective: To evaluate clinical efficacy and procedural safety of the Proximal Optimization Technique with side sequential inflation (POT-side-POT) technique in provisional stenting of non-complex Coronary Bifurcation Lesions (CBLs) in comparison with KBI. Methods: This study focused on 60 patients with CBLs under treatment during the period of June 2021 to June 2024. Participants were split into two similar groups based on technique preference (KBI or POT-side-POT). These groups were compared based on the clinical and angiographic outcomes recorded. Specifically, the primary outcomes of interest were adverse cardiac events, stent thrombosis, contrast-induced acute kidney injury (CI-AKI), SB dissection, and the need for additional SB stenting. To account for potential selection bias, the Inverse Probability Weighting (IPW) technique was applied. Results: CBLs treated during this time period displayed similar baseline demographic characteristics across each group. KBI showed longer procedure times and more contrast use. Following IPW adjustment, SB dissection and the need for additional stenting were more frequent with KBI. No mortality was recorded in the clinical follow-up and 30 days post-discharge. Subgroup analysis demonstrated considerable improvement when using the POT-side-POT technique for true bifurcation lesions, with reduced procedure times and lower rates of SB-related complications. Conclusion: For provisional stenting of non-complex CBLs, POT-side-POT offers a safe and effective strategy, reducing the risks of dissection and stent deformation, while also shortening procedure time. KBI is still valid should further SB expansion be needed.*

Keywords *- Coronary Bifurcation Lesions, POT-side-POT, Kissing Balloon Inflation, Provisional stenting, PCI, Side branch optimization.*

1. Introduction

Coronary artery disease remains the number one cause of disease burden and mortality worldwide. It accounts for more than 17 million deaths each year, with progressive ischemic heart disease being one of the largest contributors. The gradual formation of atherosclerotic plaque that causes narrowing of the coronary arteries is the most common cause of CAD. While there have been incredible advancements in CAD treatment, it continues to impose an extensive clinical and economic burden globally. Optimal treatment, such as PCI and CABG, has shifted to focal and timely detection of the disease. While the progression of PCI, especially with the introduction of DES and advancements in technique, has been nothing short of remarkable, there are still a number of complex lesions that remain difficult, particularly coronary bifurcation lesions, due to their mechanical behavior during stent deployment and complex anatomy.

Provisional stenting is the most widely accepted technique to manage non-complex bifurcations. The best method for side branch optimization, however, remains the subject of great debate. The most common approaches, KBI and POT-side-POT, lack real-world data on comparative procedural safety, efficiency, and outcomes.

Moreover, prior studies have poorly designed analyses for bias and have not addressed procedural metrics such as the use of contrast and side branch outcomes, which limit and skew the evaluation.

This research analyzes POT-side-POT and KBI within a provisional stenting framework while using inverse probability weighting for confounding control. The uniqueness of this paper is in its contribution of procedural safety, efficiency, and SB outcomes in a single-center, real-world cohort from which it identifies which method best optimizes one's trade-off between efficacy and simplicity in a stenting procedure.

There have been a number of studies on different stenting strategies for stenting bifurcations. Lassen et al. and

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Burzotta et al. pointed out that CBLs are not only a problem in 15–20% of PCI cases, but they also add the problem of restenosis and SB occlusion. Though Pan et al. showed that KBI improves SB lumen, it also has the potential to create stent deformation. POT-side-POT, as introduced by Colombo et al, optimizes proximal stent geometry while minimizing mechanical distortion. The added procedural efficiency and decreased SB dissection reported in the rePOT and PROPOT trials were unaccompanied by comparative observations on POT-side-POT. The present study aims to address the gap in the literature, which directly compares both methods from similarly designed procedures in a propensity framework.

2. Materials and Methods

A retrospective analysis was conducted at Latakia University Hospital from June 2021 until June 2024. The sample included 60 patients who had PCI for CBLs—30 with POT-side-POT and 30 with KBI. The standard operational protocols for inclusion and exclusion criteria, procedure documentation, pharmacotherapy, and stent types were applied.

The statistical package SPSS 22 was used for analyses. Continuous data were reported as a mean ± SD, or median (IQR), and categorical data as counts. For comparison, Student's t-test, Mann–Whitney U, Chi-square, and regression for logistic analysis were used. By using propensity-based IPW, the selection bias was offset and adjusted. A cutoff of $P < 0.05$ was the accepted statistical significance. The comparative data on procedural efficiency, safety, and biomechanical outcomes are included in the respective tables (Tables 1 and 2).

3. Results

Tables 1 and 2 illustrate that both techniques were performed under comparable baseline and angiographic conditions. KBI procedures required a longer duration and larger volume of contrast. After IPW adjustment, there was a greater frequency of SB dissection and the requirement for additional SB stenting with KBI. No deaths were found in the hospital or in the 30-day follow-up. The analysis confirmed the primary findings, even when excluding lesions in the left main.

Subgroup evaluation indicated that POT-side-POT led to better results in actual bifurcations (Medina 1-0-1, 0-1-1, 1-1-1), showing lower rates of SB injury and thrombosis while maintaining continuous flow and not causing CI-AKI. The total procedure time was less for the POT-side-POT approach (30.2 ± 8.3 mins) versus the KBI (34.9 ± 12.1 mins), $P < .001$. An analogous trend was seen in the contrast volume (152.4 ± 41.2 mL for POT-side-POT, 174.1 ± 60.4 mL for KBI) with $P < .001$. Statistically, both groups were similar in the Main Vessel Stent (MVS) diameter, 2.98 ± 0.16 vs 3.02 ± 0.31, $P = 0.041$. Though the MVS length was different between the groups, $P = 0.002$ with POT-side-POT 32.9 ± 14.1 mm versus KBI 29.5 ± 11.3 mm.

For the final MVS stent and length, 3.6 ± 0.3 mm (POT-side-POT) and 3.7 ± 0.5 mm (KBI), $P = 0.002$, indicating that both groups were similar in stenting technique and final control, as well as stent volume. The proportion of stent use in both groups was similar, 23.3% in POT-side-POT vs 30% in KBI.

In the disposition time and 30 days, there was no recorded mortality for both groups, thus both are non-compliant with the allocated mortality. AKI was present in both groups, with 3 (10%) in POT-side-POT and 5 (16.7%) in KBI.

Focusing on the side branches for stent dissection, both populations had different results with POT-side-POT having 2 (6.7%) vs KBI with 6 (20%), resulting in a Significant difference after IPW. The need for side beams was more pronounced as KBI remained 16.7% compared to POT-side 6.7% thus in both groups control provided was horizontally rather than vertically.

Table 1. Outlines the procedural and technical characteristics compared between groups

Variable	POT-side-POT (n = 30)	KBI (n = 30)	*P* value
Procedure time (min)	30.2 ± 8.3	34.9 ± 12.1	< .001
Contrast volume (mL)	152.4 ± 41.2	174.1 ± 60.4	< .001
Main vessel stent diameter (mm)	2.98 ± 0.16	3.02 ± 0.31	.041
Main vessel stent length (mm)	32.9 ± 14.1	29.5 ± 11.3	.002
Use of >1 stent, n (%)	7 (23.3%)	9 (30%)	.142
Final main vessel stent diameter (mm)	3.6 ± 0.3	3.7 ± 0.5	.002
Use of tirofiban, n (%)	2 (6.7%)	1 (3.3%)	.333

Table 2. Adverse outcomes

Variable	POT-side-POT (n = 30)	KBI (n = 30)	*P* value
In-hospital or 30-day mortality, n (%)	0 (0%)	0 (0%)	NS
Acute kidney injury due to contrast, n (%)	3 (10%)	5 (16.7%)	NS
Side branch dissection, n (%)	2 (6.7%)	6 (20%)	Significant after IPW
Need for side branch stenting, n (%)	2 (6.7%)	5 (16.7%)	Significant after IPW
Composite adverse outcomes	No significant difference	No significant difference	.982 (OR = 1.01)

4. Discussion

Bifurcation PCI cords present a challenge for the operator and pose a challenge worldwide.
For non-complex CBLs, Provisional stenting is the widely accepted method, but the approach to post-stenting optimization is influential to the outcome as well.

This research illustrates that POT-side-POT facilitates shorter procedural durations, decreases contrast use, and SB complication rates when compared to KBI. Similar to prior research (EuroIntervention 2021; Catheter Cardiovasc Interv 2020), these results further substantiate that sequential SB inflation utilizes less mechanical stress compared to simultaneous dual-balloon inflation.

4.1. Mechanistic Explanation

Proximal Optimization: POT adjusts stent apposition and vessel geometry, as well as aligns the stent to taper with the vessel.

Sequential inflation: Gradual SB inflation fosters improved dissection control and reduces subsequent mechanical strain.

Final POT: Restores the cylindrical geometry, SB homogeneity, and SB gas patency.

POT-side-POT leads to less procedural complexity as it maintains stent integrity and lower stent distortion risk when compared to KBI. Provisional stenting KBI has been stated to provide more predictable outcomes and reproducibility, as discussed in the recent registry.

For non-complex bifurcations, POT-side-POT provides added procedural efficiency that is clinically valuable in patients at risk of CI-AKI or other procedural complications. KBI may be used for suboptimal SB expansion.

4.2. Limitations

The external validity is limited due to the study's retrospective design, smaller sample size, and the lack of a comprehensive IVUS/OCT evaluation. The follow-up duration of one month is also insufficient to evaluate the long-term outcomes, which should be addressed in future research through randomized controlled trials.

4.3. Comparison with Existing Studies

Examining primary studies that compare the techniques of POT-side-POT and KBI reveals that, while both approaches are effective, they yield different results in terms of procedural details and outcomes. In the Comparative Analysis of Sequential POT-side-POT and Kissing Balloon Techniques in Patients with Coronary Bifurcation Lesions Treated with a Single Stent Strategy (2021, The Anatolian Journal of Cardiology), the author reports that the POT-side-POT technique resulted in a significantly shorter procedural time, lower contrast volume, and fewer side branch dissections compared with KBI. In the CRABBIS Trial (2025, JACC: Cardiovascular Interventions), it is reported that KBI achieved superior stent expansion in the main vessel and greater improvement in side branch geometry, whereas POT-side-POT maintained the circular configuration of the proximal main vessel, which is important for the patient's long-term outcomes. The rePOT Clinical Study (2021, EuroIntervention) demonstrated, through OCT imaging, that KBI results in greater stent malapposition and deformation, whereas POT-side-POT relieves some of these facets. The PROPOT Trial (2021, EuroIntervention) also noted that the KBI technique resulted in stent malapposition, and in certain situations, concluding that POT-side-POT does not overtly benefit compared to KBI.

All studies conclude that despite both strategies achieving the desired results, POT-side-POT is more efficient from a procedural point of view while preserving the intended stent geometry. Therefore, it is defended as the default strategy for uncomplicated bifurcation lesions. KBI should still be regarded as a valuable bailout strategy when a significant expansion in the side branch is required.

5. Conclusion

POT-side-POT achieves an ideal equilibrium between the procedural safety and the clinical efficacy of provisional bifurcation stenting. It saves time, reduces the amount of contrast used, diminishes SB complication risks, and does not negatively impact short-term results. KBI is still a practical alternative when enhanced SB expansion is needed. This data strongly supports the adoption of POT-side-POT as the default technique for uncomplicated bifurcation lesions.

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